NOISE

AN ELEMENT OF THE GENERAL PLAN, SANTA CLARA COUNTY

JULY 1976

NOISE PLAN

An Element of the General Plan
Santa Clara County

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Planning Department
314 County Administration Building
70 West Hedding Street
San Jose, California 95110
299-2521 Area Code 408

County of Santa Clara
California

August 18, 1976

We are sending you a copy of the Noise Plan, an Element of the General Plan, adopted by the Santa Clara County Board of Supervisors on July 20, 1976. This element is intended to satisfy the requirements of the State of California for noise planning.

The emphasis in this Noise Plan is on the compatibility of land uses with their noise environment. A major source of noise and conflicts with land uses is the transportation system. Therefore, the Noise Plan is closely related to the Land Use Element and Traffic Ways Element of the County General Plan, as well as the Land Use Plan for Area Surrounding Santa Clara County Airports adopted by the Santa Clara County Airport Land Use Commission.

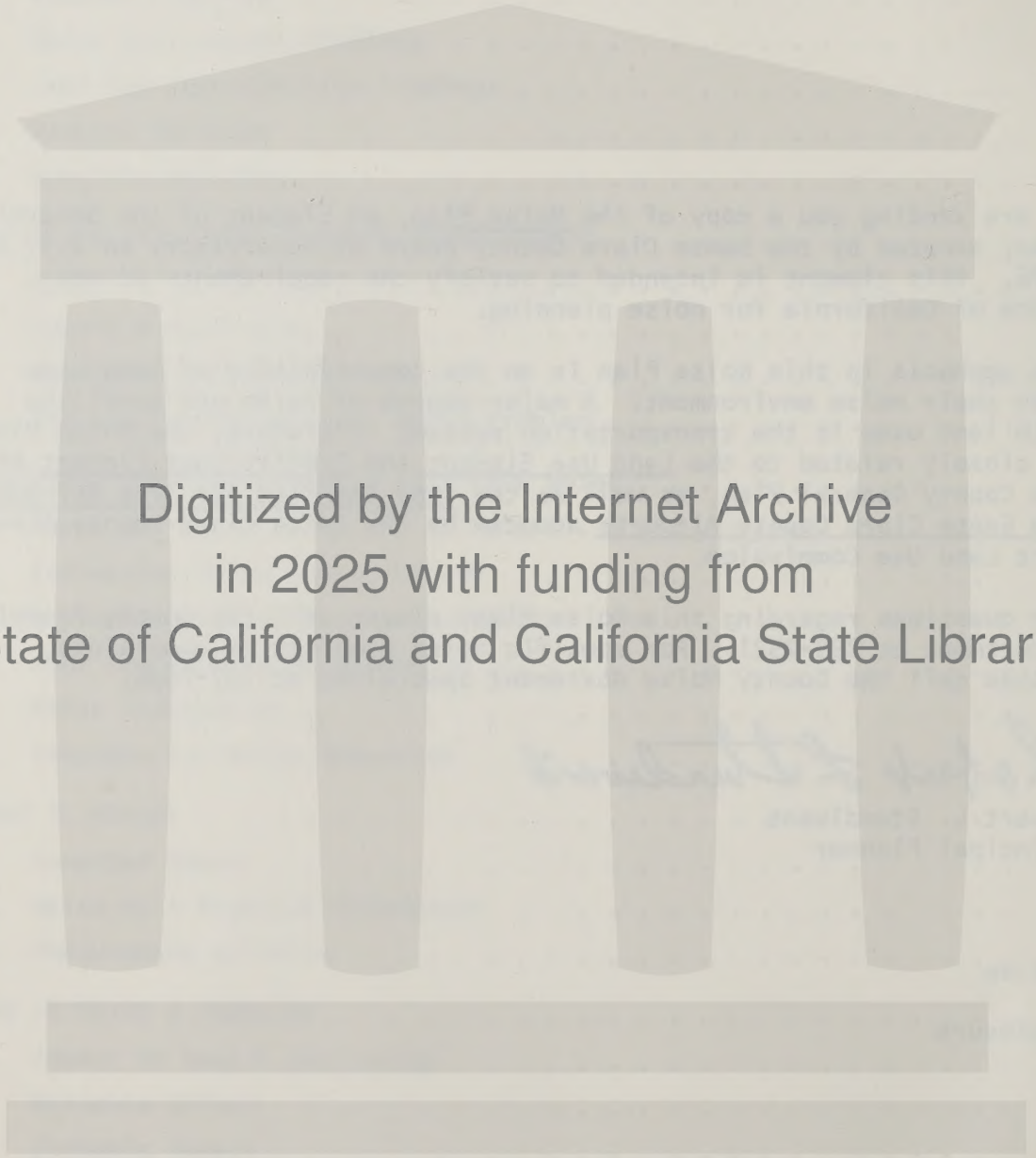
For questions regarding this Noise Plan, please call the County Planning Department at 299-2521. For specific noise problems or complaints, please call the County Noise Abatement Specialist at 297-1636.

Robert L Sturdivant

Robert L. Sturdivant
Principal Planner

RLS:ep

Enclosure



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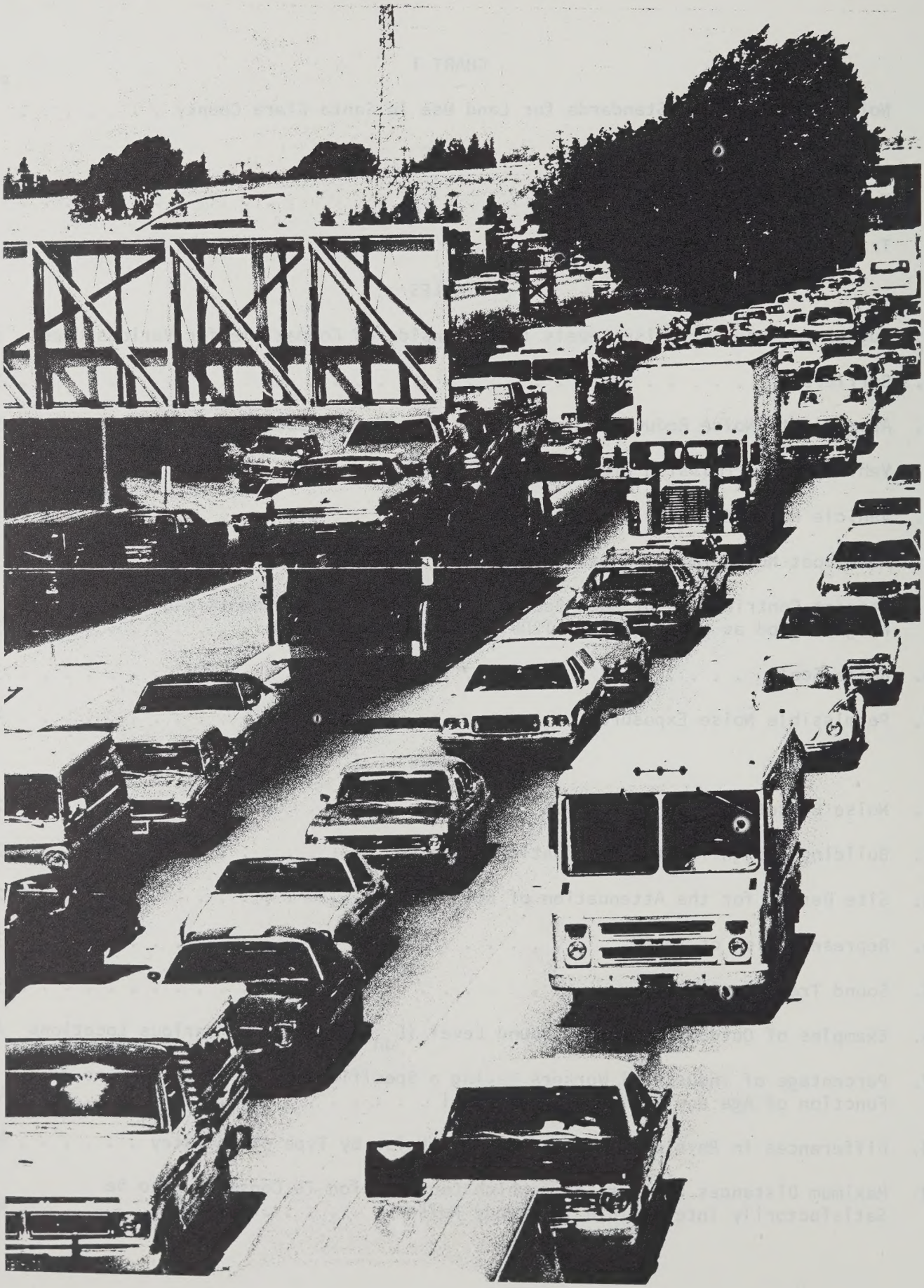


I. INTRODUCTION TO THE NOISE ELEMENT

Noise is found everywhere in the County where there is sound that is "unwanted" by someone. Some noise sources are fairly constant or of sufficiently high levels that they must be dealt with as major features in the geographic environment of the County. These major and continuing noise sources are mostly related to transportation, and are the focus of the specific land use impact information presented in the Noise Element. Where major noise sources have been documented, the Noise Element has included policies to deal with them.

Many other noise sources are either infrequent, not tied to particular locations, of significance only to small geographic areas, or not loud enough to be recognized as serious environmental problems. It would be impossible to identify all these sources of noise in the County, and the Noise Element does not attempt to provide a comprehensive inventory of local noise problems. Instead, the Noise Element provides a package of policies and proposed programs that will allow the innumerable local noise problems to be dealt with on a case by case basis.

Historically, serious attempts to control noise pollution have been sporadic and, for the most part, ineffectual. Noise ordinances have been in effect in some states since 1930, but little has been done to use them to arrest, abate, or even slow the growth rate of noise pollution. Rather, society, through its increasing mechanization and emphasis on power and speed continues to create noise of a higher level of intensity and increased area of impact.

America has been culturally conditioned to accept noise as a way of life. This conditioning starts early in life. The ill effects of noise are seldom pointed out to children. Parents encourage the acceptance of noise by buying loud toys for children and encouraging their use.

The acceptance of noise is also reinforced as a means of social recognition. Many people attach personal value to noise and use it as a vehicle to gain recognition and identity. It is also used as a means of protest. The sounds of motorcycles and unmuffled cars and loud rock music are all familiar manifestations.

The ability to tolerate an unhealthy environment has imbued people with a false sense of well-being. Most of the population does not think in terms of noise as an environmental health problem unless they are directly affected, and frequently not even then. Instead, noise to many people is equated with power and efficiency. The result is noise which endangers the individual's hearing and performance while contributing to higher noise levels in the community.

Noise in the past has received very low priority in the drive to solve social problems. Allocation of Federal and State resources has been minimal. Noise pollution has also been far down the ladder of spending on environmental protection.

Similarly, noises emitted by uses fixed to the land such as quarries or foundries had historically received the most attention. Mobile sources, such as trucks, outboard motors, or off-road vehicles, were allowed to build up to intolerable levels before attempting any controls.

One of the principal reasons for the low priority put on noise control has been that the public dislikes paying taxes to reduce noise impacts created by others. Accentuating

the public's dislike is the frequency with which these impacts are unequal in their effects (i.e., some people live beneath jet plane takeoff patterns and most do not).

Where manufacturers of noise sources (voluntarily or otherwise) reduce the noise produced by their products, the added cost will be charged to the ultimate consumer. The consumer frequently resents this added cost burden for which he can find little direct benefit. For example, it is doubtful if most motorcyclists would recognize the benefit to them of quiet engines.

There is a common concern expressed by manufacturers who would like to market products with a less adverse impact on the environment. Noise reduction is an excellent example of this concern.

A manufacturer invests large sums in quieting a product and thereby increases the cost of that product. Another company decides not to quiet its similar product and reaps a substantial increase in sales as consumers respond to its relatively lower prices. As a result, the only effective means of reducing noise generation at the source appears to be through government regulations at the state or national level setting maximum product noise levels.

Although noise pollution is adversely affecting the quality of life, few institutions have responded to the challenge. A coordination of the efforts of many agencies would be required to make any such response effective.

Legislation adequate to deal with noise pollution has been weak or nonexistent. It is too vaguely written and too narrow in scope. It tends to be enacted after the fact when noise pollution has reached crisis proportions (i.e., airport noise impact on residential areas, freeway noise impact on schools).

Regulation under existing ordinances has also been a problem. A lack of measuring equipment and manpower to enforce the law has rendered most ordinances practically useless. Just as important, police officials frequently consider burdensome the enforcement of noise nuisance laws.

Noise pollution is a direct by-product of our technologically oriented way of life. As long as it is considered an unavoidable byproduct, there appears to be little chance of slowing down the increasing noise levels in our environment. On the other hand, if we plan with the knowledge and intent to reduce noise pollution, we may finally begin reducing it to a manageable level. This Noise Element of the General Plan is hopefully a step in that direction.

In Santa Clara County, noise is an environmental pollutant which is intimately related to the patterns of physical development. The obvious impacts of noise from airports and freeways on other uses of land require that local policies be formulated to protect existing and future residents from harmful or annoying levels of unwanted sound. The noise element is to provide a body of information, policies and tools to allow future land use decisions to be made with full awareness of their noise consequences.

The Noise Element is a mandated portion of the general plan, and this report is intended to satisfy the requirements of the State of California for noise planning.

As part of the general plan, the Noise Element is very closely related to the Land Use Element. The emphasis in the element will be on the compatibility of land uses with their noise environment. A major source of noise and conflicts with land uses is the transportation system. Therefore, the Noise Element also has a direct relationship with the County Traffic Ways Element and the Land Use Plan for Area Surrounding Santa Clara County Airports adopted by the Santa Clara County Airport Land Use Commission.

Noise pollution is adversely affecting the quality of life

II. GOALS AND OBJECTIVES OF THE NOISE ELEMENT

The goals of the Noise Element are:

The protection of the public health, safety and welfare through the elimination of harmful and annoying levels of noise.

The establishment of a physical development pattern compatible with the noise environment of the County.

To achieve these goals the Noise Element has the following objectives:

To identify the present and future levels of noise in the County and to identify the noise-sensitive land uses affected by the noise levels.

To establish standards and criteria for sound levels compatible with planned physical development and human activity.

To develop an implementation program providing the tools necessary to achieve the standards for noise compatibility.

III. FINDINGS AND RECOMMENDED POLICIES

A. GENERAL FINDINGS

1. The impact of noise is a multifaceted problem:

   a. Noises of sufficient intensity have caused irreversible hearing damage.
   b. The effects of noise are cumulative and, therefore, the levels and durations of noise exposure must be taken into account in any overall evaluation.
   c. Noises have produced physiological changes.
   d. Noise can interfere with speech and other communication.
   e. Noise can be a major source of annoyance by disturbing sleep, concentration, rest, and relaxation.
   f. Noise interference with work is a significant cost of our industrial society.
   g. People often do not complain about noise despite its adverse impact on their health and general well-being.

2. In order to deal with the noise problem, it is necessary to express it as a measurable quantity. The Community noise measurement methodology selected for Santa Clara County is the Day-Night Average Sound Level (L_{dn}). L_{dn} was chosen because it:

   a. is easily related to the A-weighted sound level (dBA) commonly used to measure noise;
   b. provides a translation of a unit measure of sound into an index of annoyance for planning purposes;
   c. satisfies the State of California requirements for a Noise Element;
   d. is the index recommended by the Environmental Protection Agency;
   e. is most apt to be standardized on a nationwide basis.

3. The keys to control of noise are the three components of sound transmission; source, path, and recipient. Reduction or elimination of noise impact may be achieved through action directed at any or all of these components.

B. NOISE ENVIRONMENT FINDINGS

1. The unincorporated area of Santa Clara County is primarily rural land with a low, acceptable noise level.

2. The South Valley contains the greatest concentration of heavily noise impacted land in the rural, unincorporated portion of the County. Much of this land is undeveloped and integrating noise policies into the planning of this area may eliminate future problems of noise conflict.

3. The major source of noise in Santa Clara County is transportation; primarily vehicle movement on highways and aircraft operations.

a. Highways

(1) State and Federal requirements on new vehicles will help to reduce noise levels by 15 dBA to 30 dBA at the source by 1988. Nevertheless, a large increase in the volume of vehicle traffic could negate the beneficial impact on noise levels created by such a reduction.
(2) Construction and operation of the incomplete portion of the South Valley freeway along the east side of the Coyote Valley will create a significant impact in a rural area with a low existing noise level.
(3) During weekends or holidays, the large volume of traffic increases the noise level substantially near rural roads that provide access to scenic, natural or recreational environments.
(4) Heavy truck generated noise off major highways is especially prevalent on roads to quarries or solid waste disposal sites.

b. Aircraft Operations

(1) Retrofit programs, if implemented for commercial aircraft, are expected to reduce jet noise. However, due to the volume of traffic and the increasing demand for rapid travel between San Francisco Bay and Southern California, substantial noise reduction over existing noise levels cannot be anticipated for some time.
(2) A potential source of aircraft noise conflict in the unincorporated area is the South County Airport between Morgan Hill and Gilroy. The airport is slated to absorb much of the future expansion of general aviation in the County.

C. LAND USE COMPATIBILITY FINDINGS

1. Land use compatibility with noise requires methods to review new projects and redevelopment proposals with relation to the ambient noise level. Following review, the County should be in a position to either accept or reject the project, or to propose modifications.

2. Because existing or unforeseen cases of noise incompatibility may be brought to light, the County must have available powers to cure as well as prevent noise conflict with land uses.

3. Based on observation of how noise levels interfere with the performance or enjoyment of various activities, standards may be developed to express the compatibility of land uses with specific noise levels. With these standards, the present or projected noise levels in the county can be matched against existing or proposed land uses to determine the existence and the degree of incompatibility.

D. GENERAL POLICIES

1. The County should adopt Chart 1, Noise Compatibility Standards for Land Use in Santa Clara County and Table 1, Suggested Interior Noise Levels Considered Compatible for Various Uses to indicate the standards by which noise compatibility will be determined in Santa Clara County.

2. The County should establish noise referral zones along existing or proposed major transportation routes. Proposed projects within these zones should be examined for noise impact. Where potential noise incompatibility is determined to exist, action should be taken to eliminate or mitigate any possible conflict.

3. The County shall seek consistency with the cities in identifying and resolving cases of noise incompatibility on unincorporated land within the Urban Service Areas. Within Urban Service Areas, noise referral zones will be based on noise contour information contained in city noise elements.

4. Where permitted land uses in the noise referral zones are determined to be in "critical" conflict with the ambient noise level, as determined by the noise compatibility standards, revision of the zoning map should be seriously considered.

5. No proposed project should generate noise which violates the noise ordinance or results in a noise level above "satisfactory", as determined by the noise compatibility standards, on nearby property. The responsible developer shall reduce or buffer the noise generated therein so as not to create an unsatisfactory noise environment for others.

6. County policies, with respect to noise, shall be consistent with Airport Land Use Commission policies for land uses within ALUC jurisdiction.

E. SPECIFIC POLICIES

1. The County should utilize the Model Noise Ordinance being developed by the State of California as a basis for writing its own noise ordinance.

2. The County should adopt the 1976 edition of the Uniform Building Code (with its noise section) when it is published.

3. The County should periodically monitor noise levels in the unincorporated area.

4. Height restrictions on walls, where the wall is to be used for noise attenuation, should be changed so as to facilitate noise attenuation.

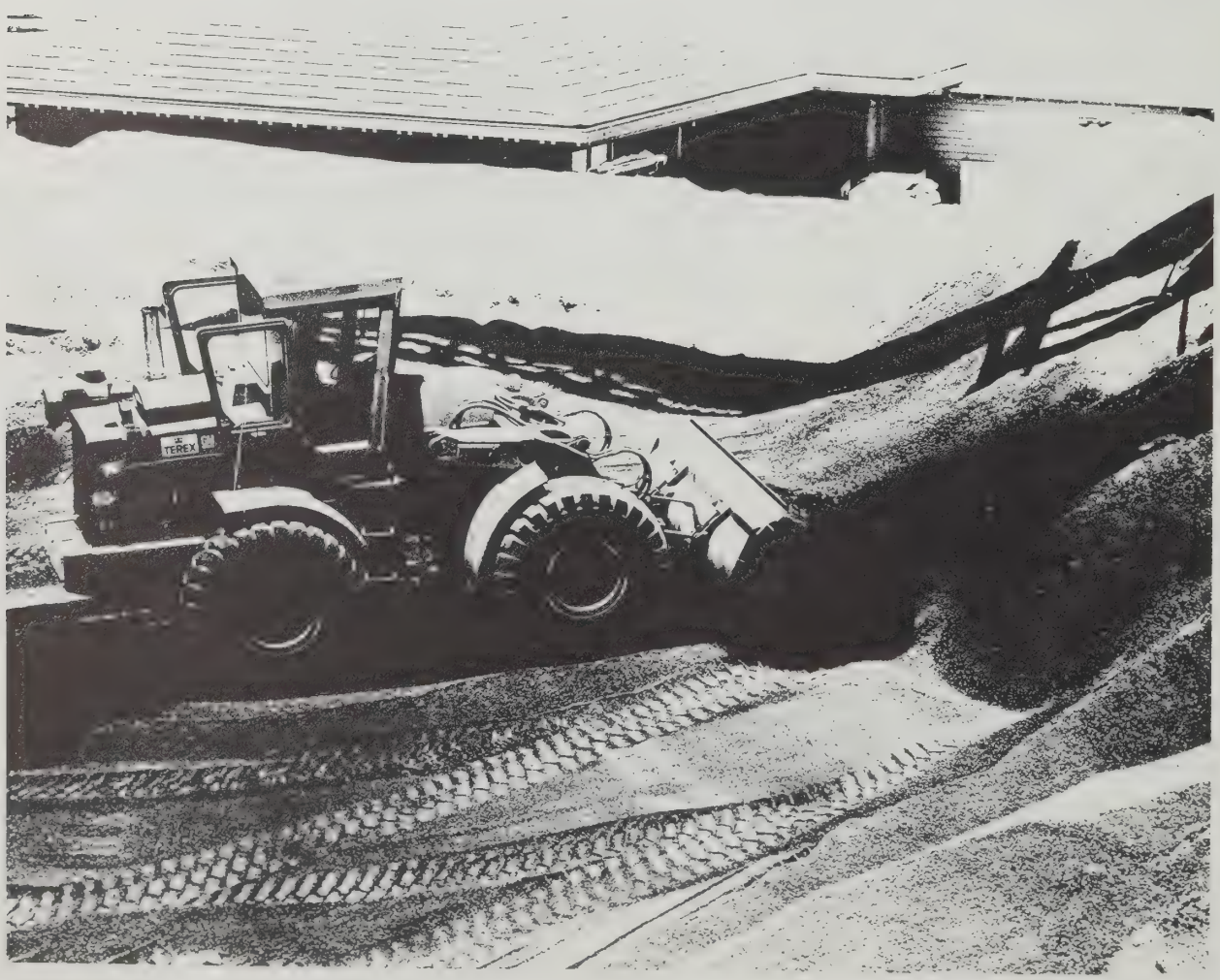
5. A noise abatement unit of County government should be established to identify and correct vehicles that violate state noise emission standards in rural, unincorporated areas of the County outside of the jurisdiction of the Highway Patrol.

6. Where a large volume of complaints occurs relating to truck noise along a particular road, it should be taken as an indication of the need to eliminate heavy trucks from that road or otherwise reduce the noise problem. Wherever feasible, trucks should be routed onto freeways and nonresidential secondary roads, even where such routing is not the shortest distance between points.

7. Where feasible, the State and County should continue to identify and protect (with barriers or other means) areas adjacent to existing and future freeways and expressways which are impacted by incompatible noise levels.

8. The County should request the Federal Aviation Administration to strictly enforce adherence to standard flight paths and airport approach patterns by commercial aircraft pilots whenever frequent violations are determined to have occurred.

9. Upon the adoption by the Environmental Protection Agency of equipment noise standards, the County should incorporate the Environmental Protection Agency standards as specifications for the modification of old equipment and the purchase of new equipment where the benefits are believed to outweigh any added costs.



IV. THE NOISE SITUATION IN SANTA CLARA COUNTY

A. OVERVIEW

Santa Clara County has been one of the fastest growing metropolitan areas in the United States, increasing in population 65.7 percent during the 1960s. The County's urbanization has occurred in a leap-frog manner due to the economics and availability of land. Consequently, a commuter pattern has evolved where there are more automobiles on the County roads traveling a greater distance than ever before. Additionally, due to the increase in population, demand has expanded for rural recreation in both the Santa Cruz and Diablo Mountain areas.

Along with the increase in population and automobiles, the County of Santa Clara has experienced a dramatic noise increase in both urban and rural environs. Transportation* is the major source of this noise.

The Noise Element was initiated with a survey to determine the existing acoustical environment in the unincorporated areas. The survey was intended to estabish noise levels to help the Planning Commission set noise standards. The goal of the standards is to preserve low noise levels where they exist today and to lower high noise levels in other areas for the protection of the health, safety, and welfare of the citizens.

B. COUNTY NOISE SURVEY

The community noise measurement survey was conducted largely in the unincorporated areas of Santa Clara County during the fall of 1974. Specific types of land uses, activities and noise sources were investigated. Information was obtained on the level, duration and character of their associated noises. A wide diversity of noise sources was measured; ranging in strength from exploding dynamite to light rain falling on the leaves of trees.

The noise survey established a base noise level from which to evaluate future land use planning decisions. A truly representative base level depended on the accuracy of individual noise measurements made in conjunction with the various land uses/activities under study. The accuracy could only be accomplished by monitoring during periods of characteristic activity. A further requirement was that the noise measurement cover statistically significant periods of time. The diversity of sites, land uses and activities made it necessary to sample community noise at all times of the day, on weekends, and holidays. The actual sites and activities studied were chosen for their relevance to current and future policy decisions.**

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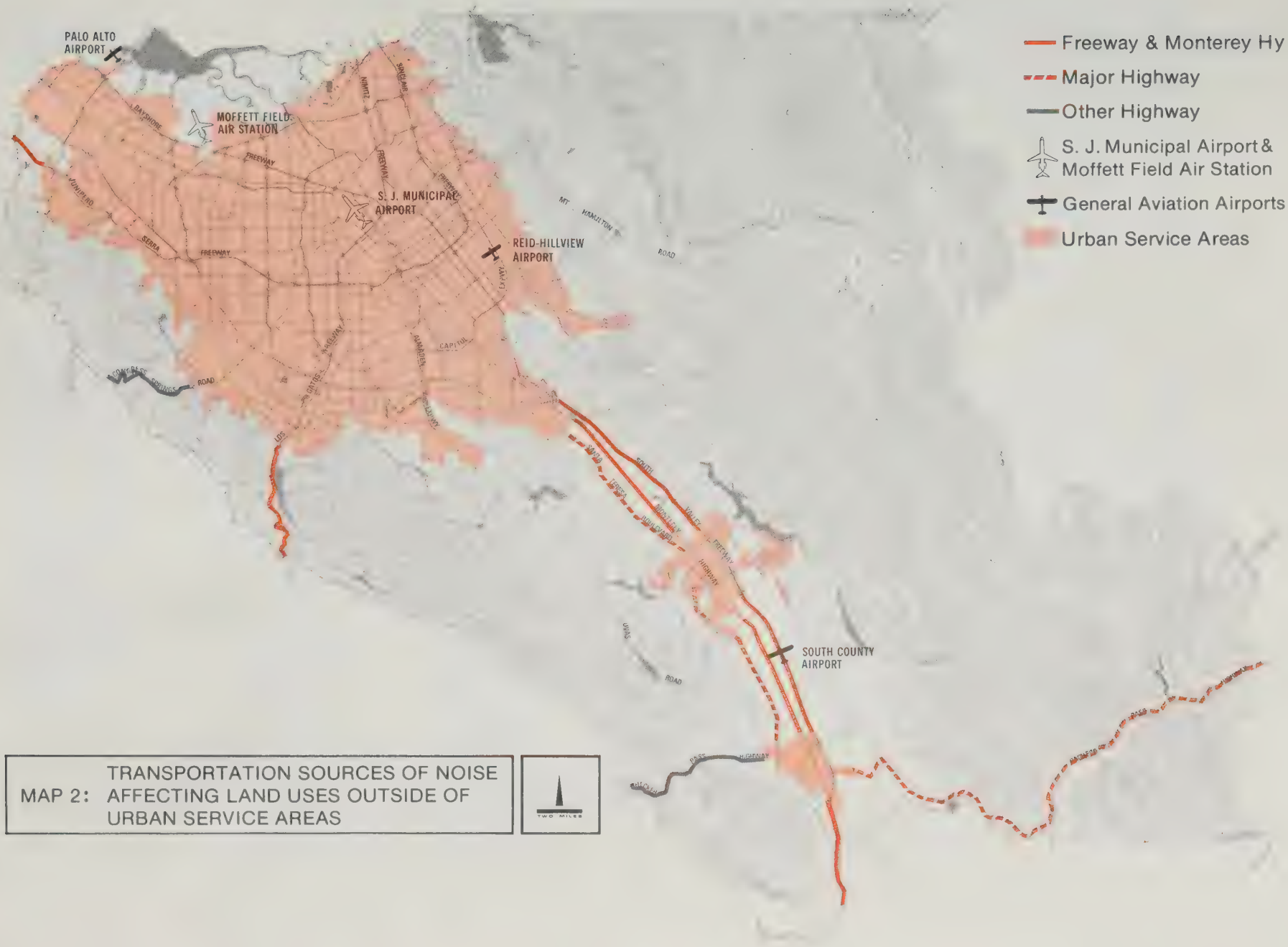
*The term "transportation", as used in this document, refers to transportation facilities, transportation vehicles and the interaction between the facilities and the vehicles.

**Map 1 is a generalized map of the individual noise measurement sites. Appendix A summarizes the community noise survey by land use category (Tables a, b, & c) and by impact from freeway noise (Table d).


• Noise Measurement Sites
Urban Service Areas
MAP 1: NOISE MEASUREMENT SITES IN SANTA CLARA COUNTY
TWO MILES



MAP 2: TRANSPORTATION SOURCES OF NOISE AFFECTING LAND USES OUTSIDE OF URBAN SERVICE AREAS

C. THE NOISE ENVIRONMENT*

The noise survey indicates that the major source of noise in the County is transportation, primarily surface traffic and aircraft operations.** Other major noise sources include extractive and industrial related activities.

Of the rural sections of the County, the South Valley contains the greatest amount of heavily noise impacted land. The specific noise source is the narrow transportation corridor of highways and railroad along the Valley floor. Any future urbanization along the transportation corridor should be rigorously reviewed for compatibility with the high ambient noise level.

Aircraft operations are a major noise source in Santa Clara County. Their impact is concentrated along the approach and takeoff patterns to the airports in the County. However, because non-commercial aircraft are not restricted to these flight patterns, their noise is present throughout the County.

The undeveloped, natural areas of the Santa Cruz and Diablo Mountain Ranges exhibit the lowest noise levels found in the County during weekday/non-holiday time periods. However, during weekends or holidays, the large volume of traffic increases the noise level substantially near the roadways. The same phenomenon occurs on all rural roads in the County that provide access to scenic, natural or recreational environments.

According to the noise measurements, high intensity rural recreation areas, such as the County reservoirs, are minor noise sources on weekends compared to the rural roads which serve them. Nevertheless, the noise annoyance character of a loud motor boat on a mountain reservoir or of an off-the-road vehicle on a baylands or mountain hiking trail cannot be ignored.

The mountain areas are also subjected to weekday noise created by quarry operations. The major noise sources from quarries are diesel-powered trucks and equipment utilized for transporting raw materials. Another source is occasional dynamite blasts. Surprisingly, in most cases, the impact on surrounding land uses of on-site blasting operations was not as adverse as the diesel-powered trucks. This unexpected situation arose from the physical shielding of the quarries by the surrounding hills. These hills acted as very effective sound barriers.

The baylands north of the Bayshore Freeway contain uses varying from quiet marshes and salt ponds to relatively noisy industrial sites, land fill operations, and high intensity recreational areas. Nevertheless, the primary noise source is again transportation, which noise penetrates all the above uses. Highway traffic and the takeoff patterns from San Jose Municipal Airport and Moffett Field Naval Air Station are the specific noise sources.

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* In reading this chapter it might be helpful to refer to Table 8 and Figures 6 and 9 in Chapters VI and VII for a more complete understanding of the noise levels being described.

** Map 2 shows those transportation land uses with a significant noise impact in the County outside the urban service areas.

Most rural residential and agricultural areas in the County are quiet except for vehicle traffic and occasional farm equipment. The noise levels are typical of a rural environment. However, it should be clearly understood that residential noise levels are primarily the result of individual vehicular noise levels and traffic volume. A residential area near the Monterey Highway may have an ambient noise level of 65 decibels or above while the equivalent level in a residential area near a rural road may be less than 45 decibels. Therefore, if such rural areas were developed for greater density in population, the consequent increase in traffic could increase noise substantially over existing ambient levels.

Within the Urban Service Areas, there are numerous streets generating high levels of noise. The noise impact of these urban streets is being identified in the city noise elements. The results of these city studies will be integrated into the implementation of the county noise element with regard to unincorporated land in the Urban Service Areas.

D. TRANSPORTATION -- THE KEY NOISE PROBLEM

Along portions of the Monterey Highway and the South Valley Freeway, the 65 decibel noise level reaches more than 500 feet from the right of way. All areas located adjacent to existing and future major highway routes will experience high noise levels until tire and engine design technology reduces vehicular noise emissions. State and Federal requirements on new vehicles will help reduce noise levels by 15 dBA to 30 dBA at the source by 1988. Nevertheless, a large increase in the volume of vehicle traffic could negate the beneficial impact on noise levels created by such a reduction.

A significant future transportation noise problem may be created by the still incomplete South Valley Freeway. The current "adopted route" is along the east side of the Coyote Valley. Its construction and operation would have a noise impact on rural land with a low existing noise level. Careful noise impact planning should precede such an eastward expansion of the South Valley transportation corridor. Otherwise, there is a clear danger we will expand and repeat the noise problems now evident along the Monterey Highway.

Aircraft noise will remain a problem for the County due to the proliferation of private and commercial aircraft in the South San Francisco Bay and Santa Clara County area. Within 1,000 feet of commercial jet aircraft, maximum noise levels of 100 dBA or greater can occur. The 65 decibel noise level at San Jose Municipal Airport extends about 3 miles south of the runway. Retrofit programs for commercial carriers are expected to reduce jet noise somewhat. However, due to the volume of jet aircraft flying above the County between San Francisco Bay and Southern California, substantial noise reduction over existing noise levels cannot be anticipated for some time.

The main railroad lines running north and south through Gilroy and San Jose are noisy. Noise levels of 60 decibels or greater can be expected to occur at 300 feet from the right of way. The maximum noise level as a train passes may be as much as 80 decibels at that distance. However, rail noise has been found to be seasonal in nature on lines other than the main lines. Even the seasonal traffic is intermittent, with a maximum of two to four trains per day with an average speed ranging from three to six miles per hour.

A potential source of aircraft noise conflict in the unincorporated area is the South County Airport between Morgan Hill and Gilroy. The airport is slated to absorb much of the future expansion of general aviation in the County. Again, careful planning, in conjunction with the Santa Clara County Airport Land Use Commission, will be required. The planning goal will be to avoid land use conflicts with the noise generated by aircraft landing and departing the airport. The current County program of purchasing land in the airport environs should also help eliminate potential noise impact on conflicting uses.

The large volume of weekend and holiday traffic increases the noise level substantially near the roadways that provide access to scenic, natural or recreational environments.

V. ACHIEVING LAND USE COMPATIBILITY WITH NOISE

A. OVERVIEW

Land use compatibility with noise requires methods to review new projects and redevelopment proposals with relation to the ambient noise level. Following review, the County should be in a position to either accept or reject the project, or to propose modifications. Because existing or unforeseen cases of noise incompatibility may occur, the County must also have available curative as well as preventive approaches to noise. In particular, the County requires the means to control the noise situation in the rural areas that are, or will be, under pressure for urban development.

Noise compatibility measures are directed at the three components of sound: source, transmission path, and recipient.* Noise can be made compatible by reduction of the noise at its source, modification of the path such as increasing the distance between source and recipient, or insulating the recipient. Other methods include shielding the recipient from the source, altering the nature of the transmission by changing the frequency of the noise source or isolating vibrating elements, or altering the recipient by utilizing the land for another purpose.

B. EVALUATING NOISE COMPATIBILITY

Before efforts are begun to reduce noise conflict, it is necessary to know what constitutes noise incompatibility with a particular land use (recipient). Noise which may create an impossible situation in someone's home, may be quite acceptable in an industrial area.

Based on observation of how noise levels interfere with the performance or enjoyment of various activities, standards may be developed to express the compatibility of land uses with specific noise levels. With these standards, the present or future noise levels can be matched against existing or proposed land uses to determine the existence and the degree of incompatibility.

Hearing damage is the most obvious health hazard to be avoided through noise control. Clearly, unprotected human activity should not occur at noise levels which may eventually result in the reduction of hearing ability.

However, for most people, exposure to everyday noise levels rarely presents this hazard. Therefore, interference with sleep and communication is a more practical standard to be applied in determining acceptable noise levels. Supplement this with the desire for quiet in places such as libraries, classrooms, and parks, and it becomes possible to develop a system of noise tolerance standards for categories of land use.

Various land use categories in Santa Clara County have been calibrated to exterior noise levels thought compatible to human activities normally occuring in the particular land use. The noise levels, as shown in Chart 1,

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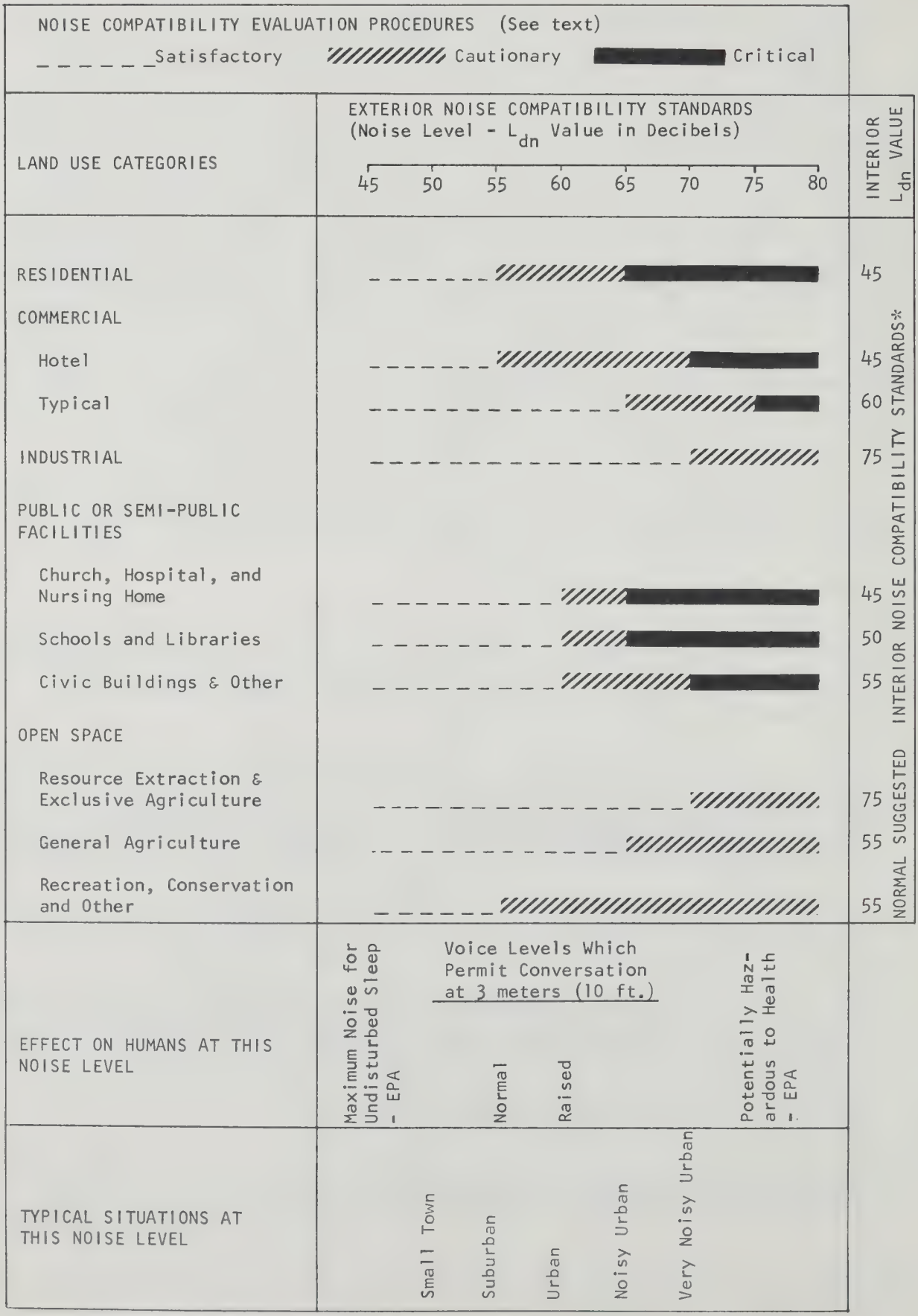
*Throughout this chapter the term "recipient" may be considered synonymous with a specific land area impacted by noise.

CHART I. NOISE COMPATIBILITY STANDARDS FOR LAND USE IN SANTA CLARA COUNTY



* See Table 1 for specific interior levels

are represented by their L_{dn} value in decibels. The levels shown on this Noise Compatibility Chart range between 45 and 80 decibels. No unprotected human activities should normally take place on land impacted by an L_{dn} above 75.

Proposed projects are evaluated for their noise compatibility when they are located in a Noise Referral Zone and when they are considered potential sources of incompatible noise. All applicants for permits on proposed projects located in this Noise Referral Zone must submit site and construction plans to the County for evaluation.

1. NOISE REFERRAL ZONE

The Noise Referral Zone is a triggering mechanism for evaluating any proposed project within areas affected by potential adverse noise levels. If a proposed project falls in a Noise Referral Zone, the project would be referred to the County Planning Department for evaluation and review. Where the project is within the jurisdiction of the Airport Land Use Commission, referral will continue to be made to that agency.

For unincorporated land within the Urban Service Areas, Noise Referral Zones will be established based on noise contour information contained within city noise elements. For that part of the county outside the Urban Service Areas, the Noise Referral Zone is defined as that land area impacted by noise levels of more than 55 decibels. The maximum "satisfactory" noise level for residential uses is 55 decibels.

A 55 decibel noise level is not found on most existing highway noise contour maps. Therefore, that noise level shall be considered to be a certain distance from the centerline of the highway. This distance is not an arbitrary figure, but a conservative estimate based on the assumption that noise levels drop 6 decibels with a doubling of the distance from the source. The distance is 1,000 feet for all existing and proposed freeways, Highway 17, and the Monterey Highway. Similarly, the distance is: 500 feet for Pacheco Pass Road (Route 152) and Santa Teresa Boulevard (plus its proposed southerly extensions); 300 feet for Hecker Pass Road (Route 152 west); and 200 feet for Congress Springs Road (Route 9).

Contour maps of noise levels within the Noise Referral Zones, as well as elsewhere, have been prepared by the Santa Clara County Transportation Agency, the California Department of Transportation and the Santa Clara County Airport Land Use Commission. The noise level contour maps may be updated when significant changes in the ambient noise levels have occurred or new information has become available.

The ambient noise level at the site of a proposed project near an existing highway may be obtained through either the noise level contour maps or direct measurement. Maps of the projected noise level contours must determine the "ambient" noise level in the case of incompleted major highways.* Once known, the ambient noise level will be used in conjunction with the Noise Compatibility Standards to ascertain the noise evaluation procedure required of a proposed project.

2. Noise Compatibility Evaluation Procedures

As presented in Chart 1, Noise Compatibility Standards for Land Use in Santa Clara County, there are three procedures for the evaluation of potential noise incompatibility. Each encompasses a spectrum of exterior (i.e., ambient) noise levels in the presence of which a land use category will be evaluated in a certain manner. These "Noise Compatibility Evaluation Procedures" are defined as follows:

a. Satisfactory

The ambient noise level is compatible with the land use category of the proposed project and will not create annoyance and activity interference. According to this evaluation procedure, noise studies or attenuation measures will be imposed on the developer only if the proposed development is itself considered a source of incompatible noise for a nearby land use.

b. Cautionary

The ambient noise level is great enough to require study on the compatibility of the proposed project. Comparison of proposed construction design with building type noise attenuation charts, combined with knowledge of the extent, location and type of expected outdoor use, will provide staff with a fairly clear idea of the compatibility of interior and exterior activities in the proposal with the ambient noise level.

As a result of staff evaluation, the County will require, if so indicated, certain noise attentuation procedures. Such procedures will not be required if a noise expert** can show, to the County's satisfaction: (a) the actual ambient noise level measured on the site is compatible with the proposed project,*** or (b) the noise where people will normally be located on the property (inside and/or outside) is at a compatible level, or (c) the applicant has agreed

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*Incomplete Coyote Valley Section of Highway 101 and Santa Teresa Boulevard.

**Registered professional, competent in the field of noise and satisfactory to the County.

***The calculated noise level used by the County may be in error, or the actual ambient level may have been reduced since the original measurement or estimation was completed. Where this site is impacted by projected noise levels from an incompleted or yet to be expanded highway, these contours, rather than the actual ambient noise level, shall be the basis for measuring noise compatibility. The alternative of measuring the actual noise level will not be available.

to implement an attenuation procedure which is equally or more effective.

Noise studies and possible attenuation procedures will be imposed on the developer if the project itself is considered a source of incompatible noise for a nearby land use.

c. Critical

The ambient noise level is severe. The situation requires a rigorous analysis of the compatibility of both exterior and interior activities in the proposed project with the ambient noise level. At the indicated noise level, noise attenuation features of a sophisticated nature would be necessary within the project design to insure the protection of persons occupying the land use.

County approval will be dependent upon the applicant providing a noise expert to ascertain whether and, if so, by what means compatibility might be achieved between the proposed project and the noise level. The noise expert must show, to the County's satisfaction (a) the actual ambient noise level measured on the site is compatible with the proposed project*; or (b) the noise where people will normally be located on the property (inside and/or outside) is at a compatible level, or (c) the applicant has agreed to implement an attenuation procedure which will result in a compatible noise level.

Noise studies and possible attenuation procedures will also be imposed on the developer if the project itself is considered a source of incompatible noise for a nearby land use.

3. Exterior and Interior Noise Compatibility Standards

a. Exterior noise compatibility standards, as presented in Chart I have a dual purpose. First, they indicate the compatibility of various ambient noise levels with outdoor human activities normally associated with particular land use categories. Second, assuming normal construction methods in the land use category, they indicate the likelihood of exterior ambient noise levels resulting in interior

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*Where the site is impacted by projected noise levels from an incompleted or yet to be expanded highway, these contours rather than the actual ambient noise level shall be the basis for measuring noise compatibility.

noise levels compatible with indoor human activities common to this land use.

Compatibility with outdoor human activities refers to those portions of the proposed project to be used specifically for this purpose. Some examples would be the patio and backyard areas of residential areas, an industrial storage yard, a school playground, etc. Outdoor activities should be limited to the quietest portion of a land use. An area of transition may separate this portion from the noisier part of the land use, say adjacent to a major highway. The extent of these noise transitional areas should vary in accordance with the noise sensitivity of human activities likely to occur within the "quiet" area. Their size will also be affected by the suitability of noise attenuation methods, other than distance, applied between the human activity area and sources of the ambient noise level.

b. Interior noise compatibility standards indicating suggested maximum interior noise levels compatible with normal interior activities in each land use category are listed in the far right column of Chart I. These levels are necessarily generalized and should be supplemented by maximum noise levels recommended compatible for specific interior uses, which are shown in Table I. For example, a structure within an industrial land use may contain "staff offices" whose maximum compatible noise level is 60 decibels rather than 75 decibels as shown in Chart I for the "industrial" land use category.

In order to use these standards it is necessary to know both the exterior ambient noise level and the extent the proposed structure will reduce that level (i.e., noise attenuation). The resulting figure will be the projected noise level inside the proposed structure which can be compared to the Interior Noise Compatibility Standard. If the projected interior noise level is greater than the standard, the proposed structure is incompatible with the noise level.

The recommended compatible interior noise levels exclude noise produced within the proposed structure. Clearly, it is not the interest of Santa Clara County to regulate stereo noise, for example, when there is no adverse impact on surrounding property. Where the adverse impact of such noise reaches beyond the property line, its regulation is the subject of the section entitled "Land Use as a Noise Source."

C. IMPLEMENTATION OF THE NOISE REFERRAL ZONE

Location of property within a Noise Referral Zone will trigger a noise evaluation at such time as application is made to the County for permission to carry out an action requiring its approval. Where the evaluation shows the need for and feasibility of noise attenuation, the attenuation procedures will become a necessary condition of any permit issued by the County.

TABLE I

SUGGESTED INTERIOR NOISE LEVELS (L_{dn})
CONSIDERED COMPATIBLE FOR VARIOUS USES

Use	L_{dn}	Basis for Criteria
RESIDENTIAL	45	Undisturbed Sleep and State Law (Cal. Admin. Code, Title 25, Ch. 1, Subch. 1, Art. 4, Sect. 1092)
COMMERCIAL		
Hotel-Motel	45	Undisturbed Sleep and State Law (Cal. Admin. Code, Title 25, Ch. 1, Subch. 1, Art. 4, Sect. 1092)
Executive Offices, Conference Rooms	55	Speech communication 3.5 meters - normal voice
Staff Offices	60	Speech communication - 2 meters - normal voice
Restaurant, Markets, Retail Stores	60	Speech communication - 2 meters - normal voice
Sales, Secretarial	65	Speech communication - 1 meter - normal voice
Sports Arena, Bowling Alley, etc.	75	Speech communication - 0.7 meters or 2.25 feet- raised voice
INDUSTRIAL		
Offices (same as above)	55-60	
Laboratory	60	Speech communication - 2 meters - normal voice
Machine Shop, Assembly, & Others	75	Speech communication - 0.7 meters - raised voice
PUBLIC OR SEMI-PUBLIC FACILITY		
Concert Hall & Legitimate Theater	30	Intrusion of noise may spoil artistic affect
Auditorium, Movie Theater & Church	45	Minimize intrusion into artistic performance and speech communication - 20 meters - raised voice
Hospital, Nursing Home & Firehouse (sleeping quarters)	45	Undisturbed Sleep
School Classrooms	50	Speech communication - 6 meters - normal voice & State law (Cal. Streets & Highways Code, Sect. 216)
Library	50	Minimize interruption of reading
Other	55	Speech communication - 3.5 meters - normal voice

1. Airport Land Use Commission (ALUC) Permit

Where a proposal is located within the jurisdiction of the ALUC, a special permit is required from that agency. A permit will be issued by the ALUC only if the proposal is determined compatible with the noise and other land use policies adopted by the ALUC. Conditions may be attached to the permit so as to make the proposal compatible with ALUC noise policies.

2. Zoning

The California Government Code requires consistency of zoning with the General Plan. In relation to the Noise Element, this requirement does not require the rezoning of all land uses in the noise referral zone. Site design and noise attenuation measures will eliminate all but the most severe noise impacts. Nevertheless, where permitted land uses are determined to be in areas where the ambient noise level is "critical", revision of the zoning map should be seriously considered (i.e., land zoned single family residential where the ambient noise level is 65 L_{dn} or greater).

3. Land Development Regulations

Noise abatement methods are to be incorporated into the land development regulation process. Tools for noise abatement include: (a) modifying the pattern of streets, lot configuration, open space configuration and location; (b) widening of setbacks; (c) placement of noise barriers; (d) adjusting the location, height, and bulk of building structures; (e) restricting that portion of a land parcel which may be occupied; and (f) requiring the use of building materials or construction methods which will more substantially reduce noise levels in building interiors.

The County has three major regulation devices through which these abatement measures may be implemented. These are subdivision regulations, single site review and architectural review. These regulation devices will respond to noise conditions when the property or proposed development is located in the Noise Referral Zone.

At the time property is subdivided, the Land Development Committee will review the configuration of lots being created, as well as access and other conditions, with the objective of minimizing adverse noise impact. Where minimum size lots already exist and are proposed for development, the single site review process will check specific project plans for conformance with noise compatibility standards. For some types of projects, the County requires architectural review. Architectural review can require specific building treatment related to noise impact. However, full implementation of noise policies may require modification of County land development ordinances.

4. Building Regulations

This involves inspection of both improved and new structures for compliance with the adopted county noise policies, the Uniform Building Code, and California Noise Insulation Standards. It is recommended that the Uniform Building Code, 1976 Edition (with its noise section), be adopted upon publication. The building inspector should be provided any additional authority required to implement the noise element.

D. LAND USE AS A NOISE SOURCE

Although transportation is the major source of noise in the rural area, much noise comes from other noise sources. This latter noise is emitted by activities occurring on non-transportation land uses.

Conflicts associated with high levels of transportation noise are dealt with through the Noise Referral Zone. Where significant noise levels are generated on other land uses, a different approach is followed to achieve noise compatibility. This approach relates noise generated on one land use site to its impact on nearby land uses.

Particular land uses may become incompatible with nearby uses because of noise generated within, but impacting outside their boundaries. Conflict can occur whether the neighboring uses are of the same or different categories, but is more likely to occur in the latter case.

1. Environmental Impact Assessment

No new project should allow noise to be generated on the site, which violates the noise ordinance or results in a noise level above "satisfactory" (see Chart 1) on nearby property. The project applicant should reduce or buffer the noise generated therein so as not to create an "unsatisfactory" noise environment for others.

Part of the environmental impact review process is the evaluation of the noise impacts of proposed developments. These developments may be new transportation facilities, projects with significant traffic-generating potential, or projects which contain a noise source not related to transportation. An analysis of noise impact should spur the implementation of measures to mitigate any anticipated adverse effects.

The environmental review process will assess proposed developments for adverse impact in relation to a compatible noise level on nearby property, as set forth above. Where the resulting noise level would be "unsatisfactory" for a land use category, mitigating measures should be imposed as conditions for approval of the project.

Besides noise impact of completed developments, particular emphasis should be placed on the short-term noise impacts of construction during the environmental review process. Too often, construction noise is more than temporary and lasts for several months. The Model Noise Ordinance will have provisions limiting the hours and days of construction. Until adoption, however, mitigation measures to reduce noise impacts associated with construction should be imposed during the environmental review process as a condition for approval.

2. Noise Ordinance

The Office of Noise Control, Department of Health of the State of California will be publishing a Model Noise Ordinance early in 1976. Based on a review of an existing draft, it is recommended that the County utilize this Model Ordinance as a basis for writing its own noise ordinance. Standards for ascertaining the existence under the ordinance of various type of noise conflicts will be developed at that time.

The proposed Model Noise Ordinance will be designed to protect the existing environment where low noise levels exist. It will be a receptor use standard which protects the noise recipient by controlling the amount of noise entering the property. It is not a noise standard which sets maximum noise levels for various types of noise sources. The noise ordinance will also account for intermittent intrusive noise sources, like barking dogs, in a generally quiet area.

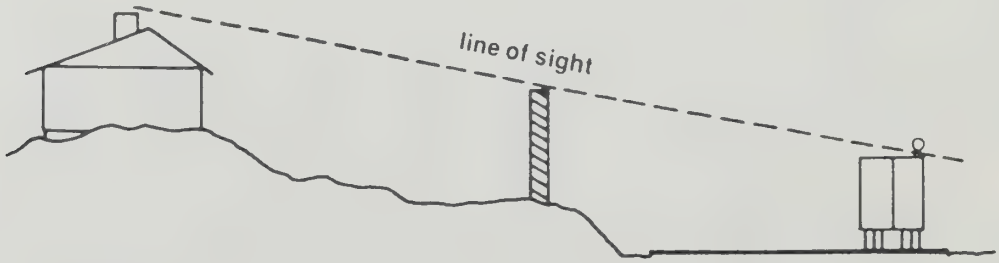
Under this ordinance, the County can order the source owner to cease and desist or mitigate the noise impact. Mitigation may come through reducing the noise level, constructing noise barriers, etc. The County may also issue variances where: (a) additional time is required to mitigate the noise impact; (b) the noise source will be of temporary duration and cannot comply with the noise limit; or (c) no other reasonable alternative is available.

E. NOISE ATTENUATION

Either as conditions of use permits or under the proposed noise ordinance, noise attenuation measures may be required of developers or land owners in Santa Clara County. In difficult cases, specially designed construction procedures may be required. However, in most cases of noise impact the measures described below would be sufficient. At any rate, they provide quantitative information to citizens as to the degree of noise attenuation feasible using rather simple procedures.

1. Barriers

Noise attenuating barriers can effectively reduce noise levels but are accompanied by high costs. 1975 estimates are running $40 per linear



foot for a 10 to 12 foot masonry barrier. The effectiveness of the barrier depends on the relative height of the barrier, the noise source, the affected area and the horizontal distance between the source and the barrier and between the barrier and the affected area. For example, a 10-foot barrier would not be entirely effective for a diesel truck with a 10-foot high exhaust stack.*

Barriers are often the only measures available to attenuate adverse noise levels. They can most effectively and at least cost be integrated into the architectural design of a proposed project in the early planning stages. Table 2 indicates the effectiveness of common barriers.

*The County Transportation Agency has found that 6 to 8 feet high masonry barriers have been effective in most cases. It believes that anything higher than this creates aesthetic and safety problems which may offset noise attenuation benefits.

Remedial barrier construction should be supported by new County policies. Existing policies set height requirements which would require a variance to construct a high wall for attenuation purposes. The County should consider modifying this height limitation if a wall is to be used for noise attenuation.

Table 2. Barriers

Type	Noise Reduction in Decibels
Earth Berm[1]	up to 15
Block Walls[2]	up to 15
Trees and Shrubs[3]	3 to 5

[1] The berm must be high enough to block line-of-sight situations.
[2] Block walls must be high enough to block line-of-sight situation. Walls must be long enough to prevent noise from going around the ends of the structure.
[3] Trees and shrubs must be mature and at least 100 feet in depth in order to attenuate noise by 3 to 5 db.

2. Trees and Shrubs

Trees and shrubs produce little physical noise reduction unless they are very dense and of significant depth. However, they may change sound frequencies in a beneficial direction. Trees and shrubs can also be beneficial by beautifying setbacks that attenuate noise. Figure 1 illustrates landscaping effects on noise reduction.

3. Building and Site Design

Buildings can be utilized to attenuate noise through proper design. If a proposal calls for a structure to be built adjacent to a noise source such as an expressway, then the exposed side of the building and the related floor plans can be designed so that the wall presents a solid surface. All windows, vents, and other normal openings should be placed away from the noise source. Similarly, sources of noise produced within the development, such as air conditioners and pool pumps, should be designed and located to direct noise away from noise sensitive areas.

Site design is one of the most effective means of protecting dwelling units in a noisy environment. If a project is proposed adjacent to a freeway or expressway, the building layout can effectively attenuate noise by placing the dwelling units as far away from the noise source as possible and placing the non-dwelling buildings and driveways between the dwelling units and the noise source. Figures 2 and 3 depict some possible ways of designing buildings and sites to help attenuate unwanted noise.

Figure 1.

NOISE REDUCTION WITH OR WITHOUT TREES

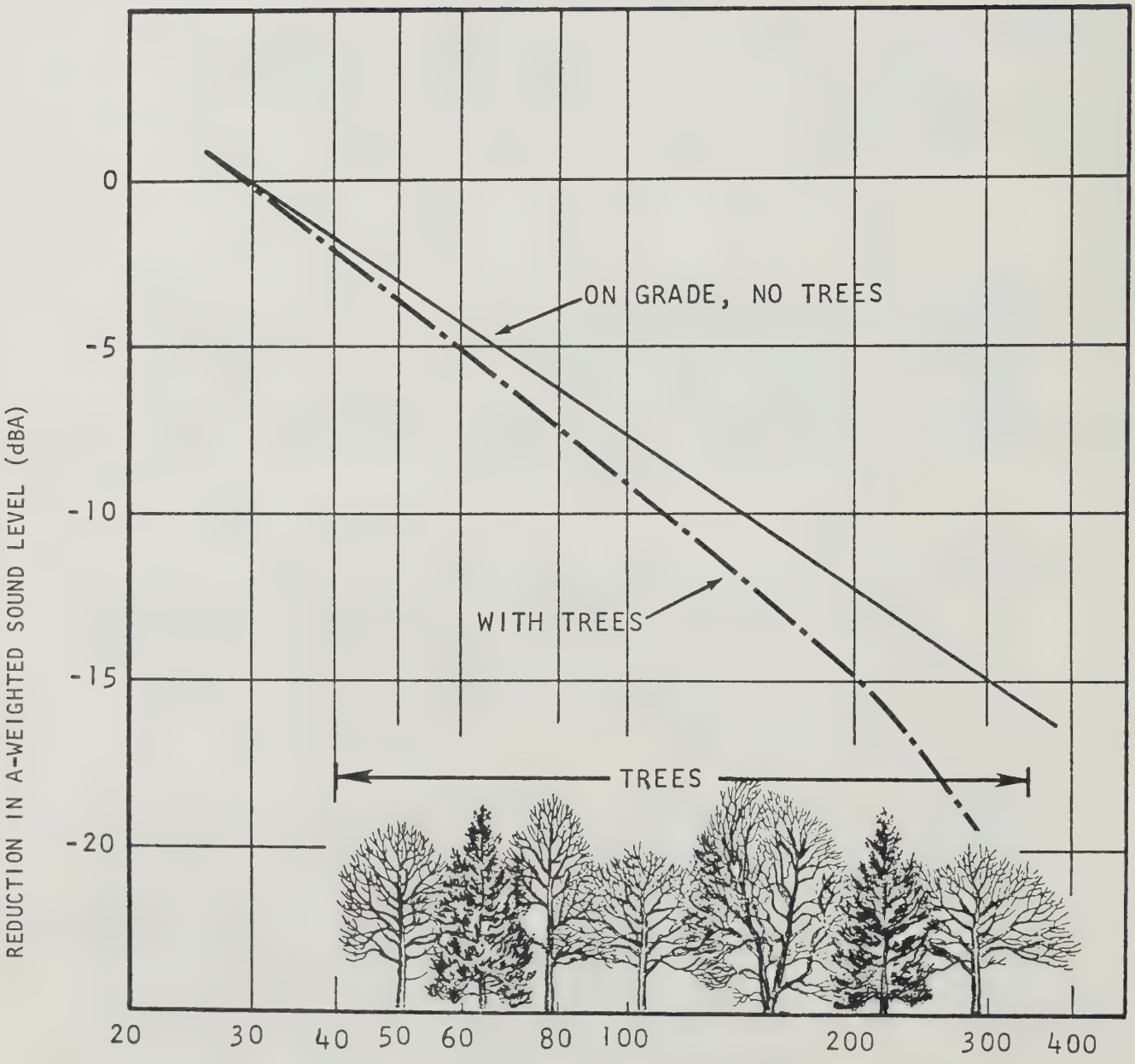


Figure 2

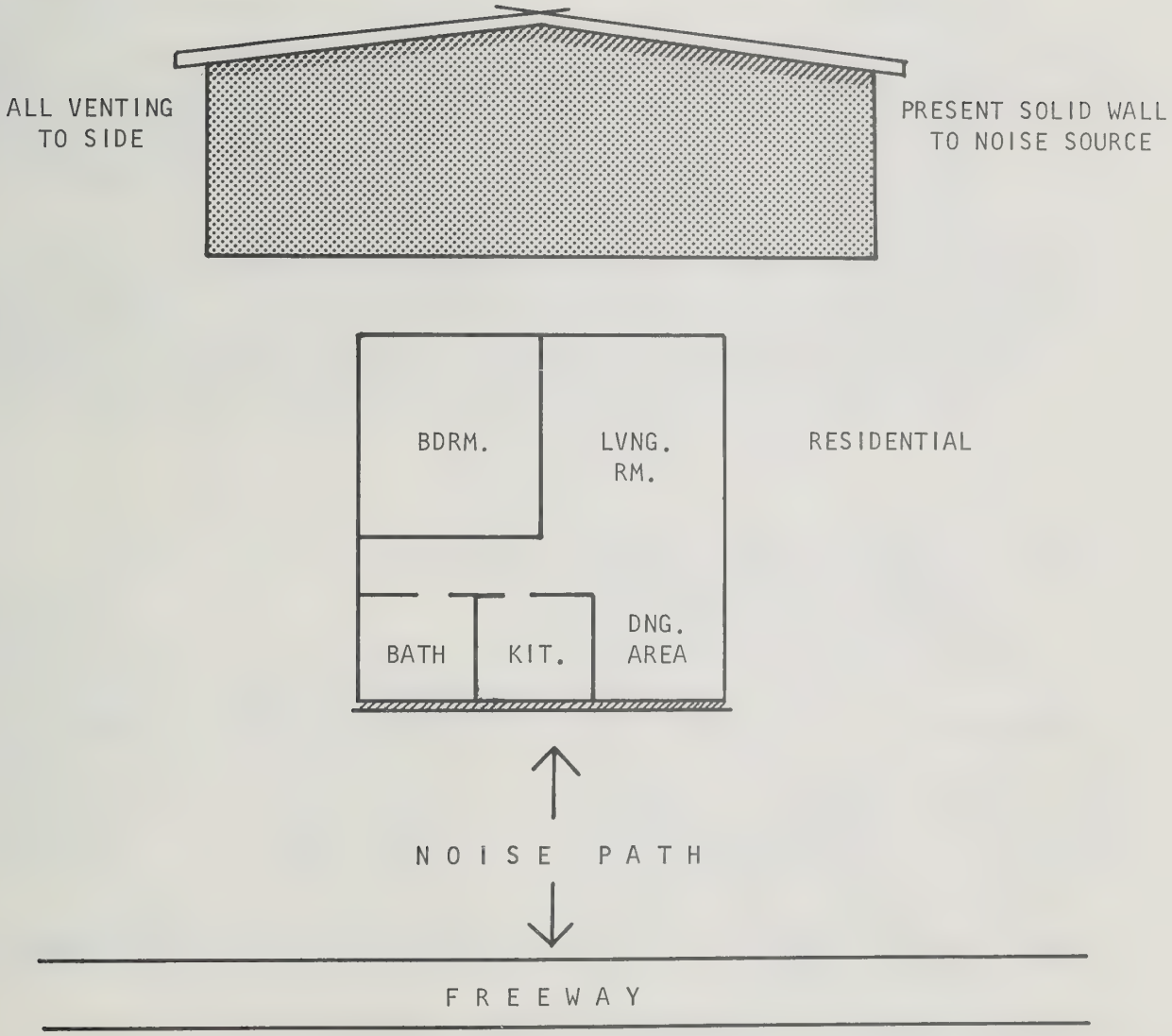
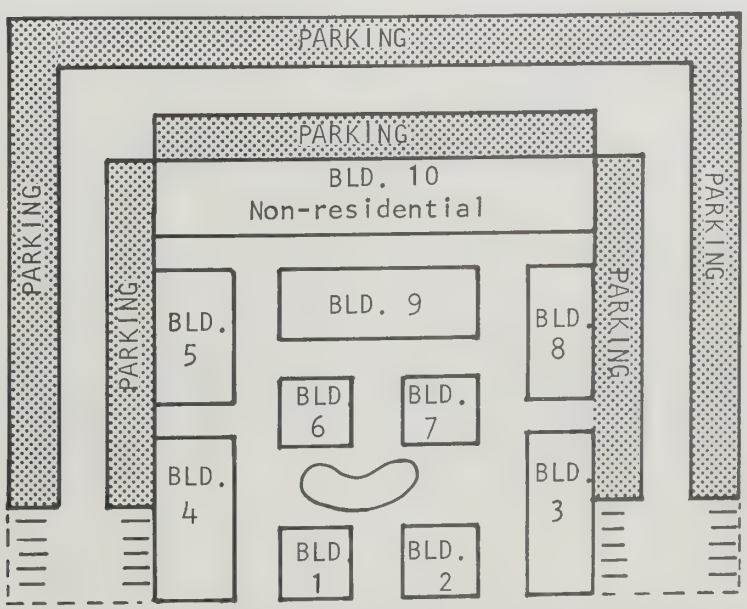


Figure 3



SITE DESIGN FOR THE ATTENUATION OF NOISE

4. Insulation

All buildings offer some insulation against the intrusion of outside noise. Table 3 shows typical noise reduction achieved through common building types and window conditions without using special noise insulation materials. The resulting differences between outdoor and indoor noise levels are crucial to judging how compatible different land uses are with different ambient noise levels.

For example, residential structures should have an interior noise level no more than 45 dBA. Where the ambient noise level is 55 dBA or less, all building types with open windows could meet this interior standard. However, in an area next to a freeway with an ambient noise level of 70 dBA, a much more substantial structure (masonry and closed single pane window) is required to satisfy the interior noise standard.

Table 3. Approximate Noise Reduction Achieved by Exterior of Common Structures*

Building Type	Window Condition	Reduction of Noise From Outside Sources	Highest Exterior Noise Level Which Would Achieve An Interior Design Noise of 45 dBA dBA
All	Open	10 decibels	55
Light frame	Ordinary sash, closed	20 decibels	65
Masonry	Single pane, closed	25 decibels	70
Masonry	Double pane, closed	35 decibels	80

Source: Federal Highway Administration, Policy and Procedure Memorandum 90-2, February 8, 1973.

*Refer to Appendix B for more detailed noise reduction tables.

F. PROGRAMS FOR NOISE REDUCTION

A high ambient noise level should never be viewed as irreducible; as a permanent part of the Santa Clara County environment from which specific developments must be protected in some manner. Frequently, the most effective and least expensive way to achieve a satisfactory noise level for a particular land use is to lower the ambient noise level.

There are numerous ways by which such a reduction might be achieved. The following programs are proposed as practical ways to facilitate such a goal in Santa Clara County. They could have special impact in certain problem areas such as the South Valley.

1. Ambient Noise Quality Monitoring

The County should periodically monitor noise levels in the unincorporated area. Monitoring would serve as evidence of the success or failure of the noise reduction programs.

2. Enforcement of Vehicle Noise Emission Standards

The California Vehicle Code has set noise emission standards both for the sale of and operation of licensed motor vehicles in California. Standards are based on the measurement of sound levels at a distance of 50 feet from the centerline of travel under established test procedures. The present operation standards (Section 23130) are the following:

Table 4

Vehicle	Maximum Permitted Noise (Decibels on the A-Scale)	
	Speed Limit of 35 MPH or Less	Speed Limit of More Than 35 MPH
Vehicle weighing more than 10,000 lbs.	86	90
Motorcycle	82	86
Other vehicle	76	82

These operation standards are enforced by the California Highway Patrol on freeways and by city police on streets in some incorporated areas.

Sections 27200-27205 governing the sale of new motor vehicles set the following standards under test procedures established by the Department of Motor Vehicles.

Table 5.

Vehicle	Maximum Permitted Noise (Decibels on the A-Scale)
Vehicle weighing 6,000 lbs. or more	
• Mfd. after 1972 and before 1975	86
• Mfd. after 1974 and before 1978	83
• Mfd. after 1977 and before 1988	80
• Mfd. after 1987	70
Motorcycle	
• Mfd. after 1972 and before 1975	86
• Mfd. after 1974 and before 1978	83
• Mfd. after 1977 and before 1988	75
• Mfd. after 1987	70
Other vehicle	
Mfd. after 1972 and before 1975	84
Mfd. after 1974	80

It is proposed that a noise abatement unit of the County government be established. It would identify vehicles that violate the noise emission standards in rural, unincorporated portions of the County outside of the Highway Patrol's jurisdiction. This unit would follow up and secure correction of the problem. Effectiveness would be measured by the number of vehicles corrected for noise violations as a percentage of all moving vehicle citations issued by the Sheriff's Department. This percentage would be compared on a yearly basis with the same percentage calculated for the Highway Patrol.

Motorboats are another noise source regulated by State law. California Motorboat Regulations, Harbors and Navigation Code, Sect. 654, 654.05, 654.06, and 668, set limitations on noise emissions from motorboats which become progressively more restrictive. The noise level measured at 50 feet from the motorboat must not exceed the following noise level:

Table 6

Motorboat Engine Manufactured	Maximum Noise Level
After January 1, 1974 and before January 1, 1976	86 dBA
On or after January 1, 1976 and before January 1, 1978	84 dBA
On or after January 1, 1978	82 dBA

This law is presently being enforced on reservoirs in this County. The enforcing agency is the County Parks and Recreation Department through its boat patrol.

3. Limitation on Heavy Truck Routes

Because community noise levels increase with the percentage of heavy trucks using the streets, it would be useful to limit the number of trucks in especially noise sensitive areas. Such a program would be required until at least 1988. In that year truck noise emissions would be reduced by the California Motor Vehicle Code to levels equivalent to most current automobiles.

Heavy truck generated noise is especially prevalent on roads to quarries and solid waste disposal sites. On some instances, the truck generated noise levels may not exceed the noise standards. Nevertheless, a nuisance exists in comparison to normal low rural noise levels. Where a large volume of complaints occurs relating to truck noise, it shall be taken as an indicator of the need to eliminate heavy trucks from that road. An analysis will then be initiated of alternative routes or other approaches to the problem.

Wherever feasible, trucks should be routed onto freeways and nonresidential secondary roads, even where such routing is not the shortest distance between points. Trucks could be scaled by weight so as to strictly limit roads available to diesel tractor/trailer combinations. The key to effectiveness of such a program, regardless of the degree roads are restricted in this way, is enforcement by the County Sheriff.

Under existing state law, the County does not have the power to establish "truck routes". A change in the law would be required to give the County this power. However, under certain circumstances, the County, under present law, may be able to deal with the truck noise problem through persuasion or conditions on use permits.

4. Limitation on Traffic Volume

Traffic volume is a critical factor in the County noise environment. It is most directly dependent on the density of development where people use cars rather than mass transit for transportation. Therefore, maintaing low allowable densities in the unincorporated portion of the County should be considered a powerful tool for a quiet environment.

As a step in regulating traffic volume, the County should continue to encourage the use of public transit. The percentage of employees using public transit or car pools could be used as a measure of effectiveness in this effort. However, until a comprehensive regional transit system is developed that would serve all parts of the County, including the South Valley and Santa Cruz Mountain areas, this approach to the reduction of noise will have little impact on rural, unincorporated areas.

5. Transportation Noise Attenuation Facilities

The State and County should continue to identify all areas adjacent to existing and future freeways and expressways which need remedial acoustical protection. Estimates should be made of the linear feet of acoustical walls or other techniques needed to provide noise attenuation.

First priority in remedial correction should be directed toward those areas found in violation of standards promulgated under State law or the County "Policy for the Installation of Fencing and Noise Attenuation--Buffering Devices on County Expressways". This county policy is presently being implemented by the County Transportation Agency (see Appendix D). Second priority should be given to any additional areas found in conflict with the noise standards adopted in the Noise Element.

6. Protection from Airport Related Noise

Air transportation is one of the more common noise sources in the County. The County should strongly support the Airport Land Use Commission (ALUC) in its effort to achieve compatibility between individual land uses and airplane generated noise. The County should also encourage the continuance of noise monitoring at San Jose Municipal Airport to determine and analyze changes in noise impacts associated with this source in accord with the California Department of Aeronautics Noise Standards (Cal. Admin. Code, Title 4, Subchapter 6, Article 3).

In rural areas affected by general aviation airports, principally South County Airport, the County should take action to protect future residents from noise levels found incompatible with ALUC noise policies for residential areas. Current land purchases in the approach areas of South County Airport go far to meet this objective.

7. Compatible Noise Levels in Schools

Under Chapter 1.4, Section 216, of the Street and Highway Code, educational facilities near freeways should be evaluated by the State to measure compliance with the 50 dBA interior noise standard. The percentage of schools that are evaluated and the percentage not in compliance that are corrected by the State would be used as a measure of the progress in achieving noise compatibility in this area.

8. Parks

In view of the fact that many outdoor recreational facilities are in potentially noisy areas, such as the Coyote Creek park chain, the County should design parks to minimize noise impacts from activities outside the park. The sites requiring acoustical treatment now or in the future should be identified and catalogued, the total cost estimated, and a program initiated to eliminate the problem.

9. County Equipment

Because the public works activities of the County involve use of mechanical equipment known to be noisy, it is desirable to establish a program for acquisition of quieter equipment. The EPA will soon begin promulgating quiet product standards. Certain types of equipment are currently available with quieter noise qualities than those presently in the County inventory. The County should develop a list of all equipment used in public projects which are suspected of having noise levels in excess of 70 dBA at 50 feet. Upon the adoption by the EPA of equipment noise standards, the County should incorporate the EPA

standards as specifications for the modification of old equipment and the purchase of new equipment. Each year, the County should list all equipment in its inventory considered noisy by the above standards. The rate of conversion of the equipment inventory to quieter machines would be used as a measure of progress in this program.

VI. WHAT IS NOISE?

A. UNWANTED SOUND

Noise is unwanted sound. Whether sound is noise depends on the sound's characteristics, location of the listener and individual likes and dislikes. What may be noise to some may be hardly noticed by another. Sensitivity to noise is specifically dependent upon a number of factors including: sound energy, frequency, and duration; distance from sound source, surroundings and time of day; the individual's age and socio-cultural background; and the physical condition of the ear.

Noise is generated by numerous sources which are found near places where people both live and work. Of particular concern are those sources generating noise levels above the average background noise level.

The most common noise sources in the community are transportation-related (automobiles, trucks, motorcycles, railroads, and aircraft). Motor vehicle noise is of concern because it happens many times and generally occurs in areas sensitive to noise exposure. Rail transit and aircraft operations, though infrequent, generate extremely high noise levels which are disruptive to human activity.

Secondary noise sources in a community include "fixed" sources such as industry and construction as well as many common activities of people. Industrial noise generated by processing and operations is generally of long duration at relatively low frequencies. Construction sources (diesel engines, air compressors, electric motors, and rock quarries, etc.) generate noise for extended periods of time with intermittent high noise levels. Noise generating human activity sources include air conditioners, lawn mowers, radio/stereo/television, sports arenas, schools and other entertainment and commercial activities.

A recent survey of persons classifying their neighborhood as noisy identified the percent of noise attributable to various sources. (See Table 7) Notice that of those sources readily identified, only human voices could not be characterized as a product of technology.

B. NOISE AS A PHYSICAL PHENOMENON

Sound is created when an object vibrates and radiates part of its energy as acoustic pressure waves through a medium, such as air, water, or a solid. Understanding noise as a physical phenomenon involves knowledge of the three characteristics of sound: energy, frequency, and duration.

Energy is measured by the level of intensity of the force behind the sound. The greater the intensity of the force, the "louder" is the sound.*

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*Technically, intensity is the amount of sound pressure or energy put forth at the source.

Table 7

PERCENT CONTRIBUTION OF EACH SOURCE IDENTIFIED BY RESPONDENTS CLASSIFYING THEIR NEIGHBORHOOD AS NOISY (72% OF 1200 RESPONDENTS)

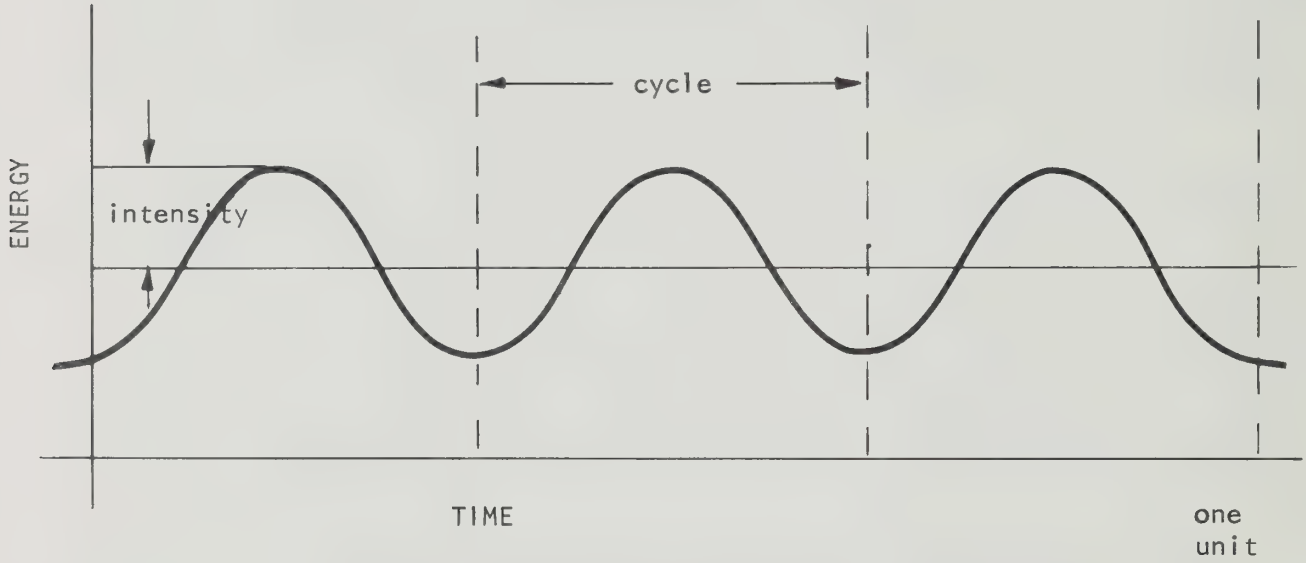
Source	Percentage
Motor Vehicles	55
Aircraft	15
Voices	12
Radio and TV Sets	2
Home Maintenance Equipment	2
Construction	1
Industrial	1
Other Noises	6
Not Ascertained	8

Source: U.S. Environmental Protection Agency. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety ("Levels Document"), March 1974, p. B-3. (There are two versions of the "Levels Document" with different pagination.)

Secondary noise sources in the community

Frequency or pitch is measured by the rate of vibration in cycles per second (hertz). High frequency sounds are produced by rapidly vibrating objects and low frequency sounds by slowly vibrating objects.

Figure 4. REPRESENTATION OF SOUND



(In this example, frequency equals 3 cycles/unit of time)

Duration of noise is a third consideration. Hearing loss, for instance, is directly affected not only by energy and frequency, but also by the time during which a person is exposed to noise.

The transmittal of sound involves three statistical components: source, transmission path, and recipient. These sound components are not independent, but experience considerable interaction. The output of the source will depend on both the path and the recipient. For example, a person (source) will raise his voice if aware that the listener (recipient) is hard of hearing. An otherwise unacceptable noise may be reduced to an acceptable level by a noise barrier across its path. Figure 5 represents the transmission of sound from a source to a listener.

Figure 5. SOUND TRANSMISSION

The ear, the hearing mechanism of humans and most animals, allows reception of acoustic energy, the amplification of faint signals, attenuation (lessening to some unknown degree) of loud signals, and conversion of sound to impulses that are transmitted to the brain for interpretation. Unfortunately, our ears, unlike our eyes, have no device to shut out unwanted stimuli. With the absence of a shielding mechanism similar to our eyelids, the ear is continually exposed to a vast array of sounds in the environment.

C. MEASUREMENT OF NOISE

Noise is measured by a special meter. The unit chosen for measuring sound energy is the decibel (dB). The decibel is measured on a logarithmic scale. Such a scale can be confusing.

A decibel level of zero is representative of the faintest sound audible to the human ear. A change of 3 decibels is normally the smallest change that a person will notice. In comparing two sounds, if the energy of the second sound is twice as powerful, it is 3 dB higher than the first; if four times as powerful, it is 6 dB higher; if eight times as powerful, it is 9 dB more intense. For every arithmetic increase in decibels which is a net gain of ten (10 dB to 20 dB or 50 dB to 60 dB), the sound energy increases geometrically ten times.

Everyday sounds normally range from 30 dB (very quiet) to 100 dB (very loud). The typical level of conversation is 55 decibels. Sound becomes physically painful above 130 decibels. Examples of various sound levels are shown in Table 8.

In assessing community noise, it is important to consider more than energy. Sound waves generated by sources of community noise consist of a range of frequencies, from the low frequency roar of traffic to the high-pitched whine of jet aircraft. Two noises having similar energy levels can display completely different frequency distributions.

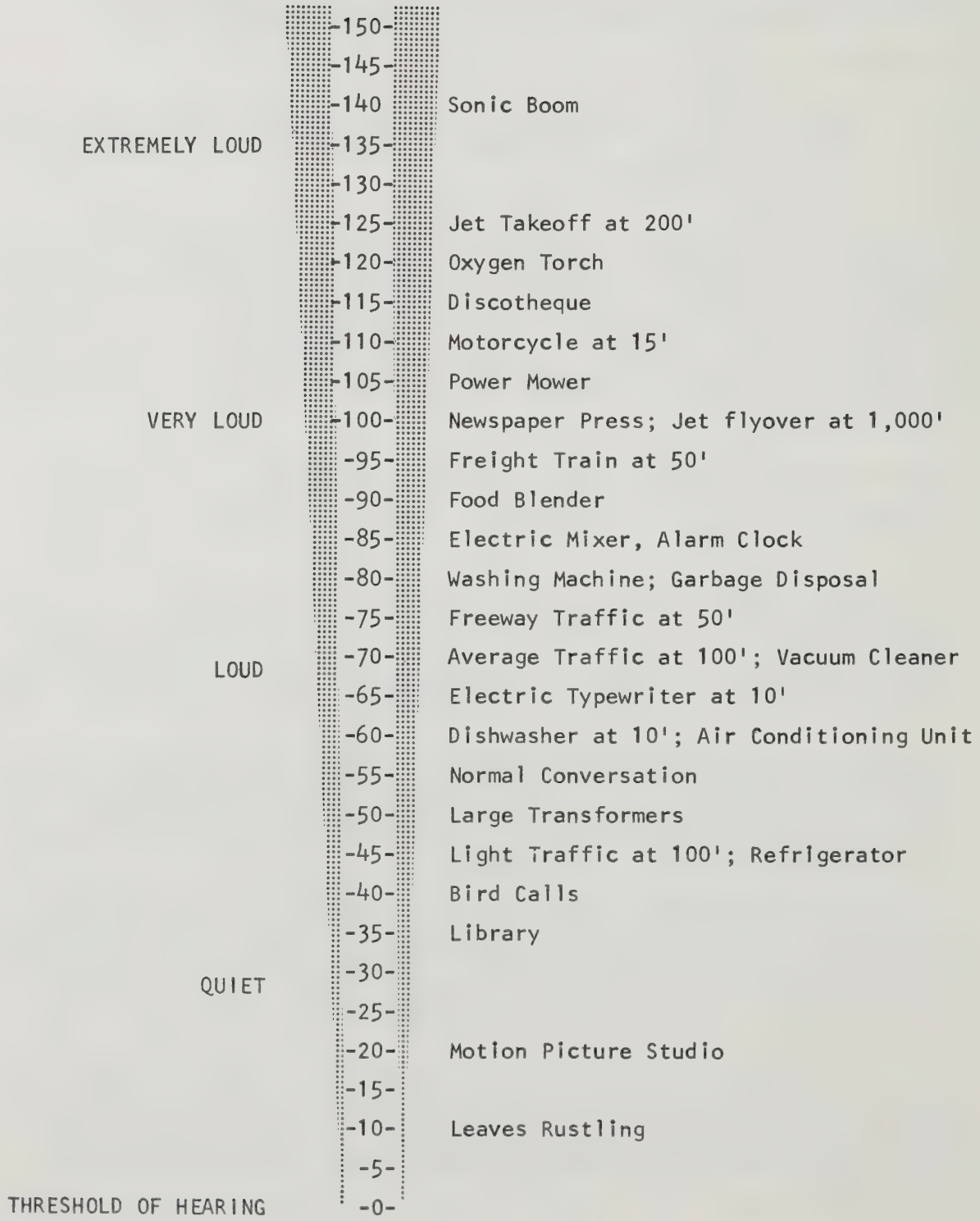
The human ear is more sensitive to some frequencies than others. As a measurement of human response, a sound meter should emphasize those frequencies which have most impact on the human ear. The sound meter scale which most closely corresponds to the way the human ear perceives sound measures the A-weighted sound level in dB (dBA).

Several noise measurement indices have been developed for the measurement of community noise. These indices account for the three characteristics of sound: energy, frequency and duration. The indices now most frequently used in California are the Community Noise Equivalent Level (CNEL), the Equivalent Sound Level (L_{eq}), and the Day-Night Average Sound Level (L_{dn}).

CNEL is a scale which takes account of the A-weighted acoustic energy received at a point over time. Weighting factors are included which place greater importance upon noise events occurring during the evening hours. CNEL is the method used for measuring noise impact around airports in California.

Table 8

NOISE SCALE



Source: Olson Laboratories, Inc.
Anaheim, California

L_{eq} is the constant sound level that, in a given situation and time period, conveys the same sound energy as the actual time-varying A-weighted sound (dBA). The United States Environmental Protection Agency (EPA) has selected this L_{eq} to identify levels of all types of environmental noise, varying from neighborhoods under airport landing patterns to deep forests. Two sounds, one of which contains twice as much energy but lasts only half as long as the other, would be characterized by the same L_{eq}, so would a sound with four times the energy lasting one-fourth as long.

L_{dn} is the same as L_{eq} except that it takes account of differences between human reaction to daytime and nighttime noise. The method characterizes nighttime noise as more severe than the same noise occurring in daytime; that is, applies a weighting factor to noise made at night. This day-night weighted measure is symbolized as L_{dn}. The L_{dn} is defined as the equivalent A-weighted sound level in decibels (L_{eq}) during a 24-hour period with a 10 dB weighting applied to nighttime (between 10 p.m. and 7 a.m.) sound levels.* Examples of the outdoor L_{dn} at typical locations are given in Figure 6.

CNEL, L_{eq} and L_{dn} are but the most recent of a number of methods developed for combining the noise from various sources into measures of cumulative noise exposure. Others commonly used in this Country include the noise exposure forecast (NEF) and the composite noise rating (CNR). One may translate from one measure to another by the following approximate relationship:

$$L_{dn} = \text{CNEL} = (\text{NEF} + 35) = (\text{CNR} - 35)$$

For most circumstances, these relationships are valid within about ± 3 dB tolerance.

The community noise measurement methodology selected for Santa Clara County was the Day-Night Average Sound Level (L_{dn}). L_{dn} was chosen because it: (1) is easily related to the A-weighted sound level (dBA); (2) satisfies the State of California requirement for a Noise Element; (3) is the index recommended by the Environmental Protection Agency; (4) is most apt to be standardized on a nationwide basis; and (5) provides a translation of a unit measure of sound into an index of annoyance for planning purposes.

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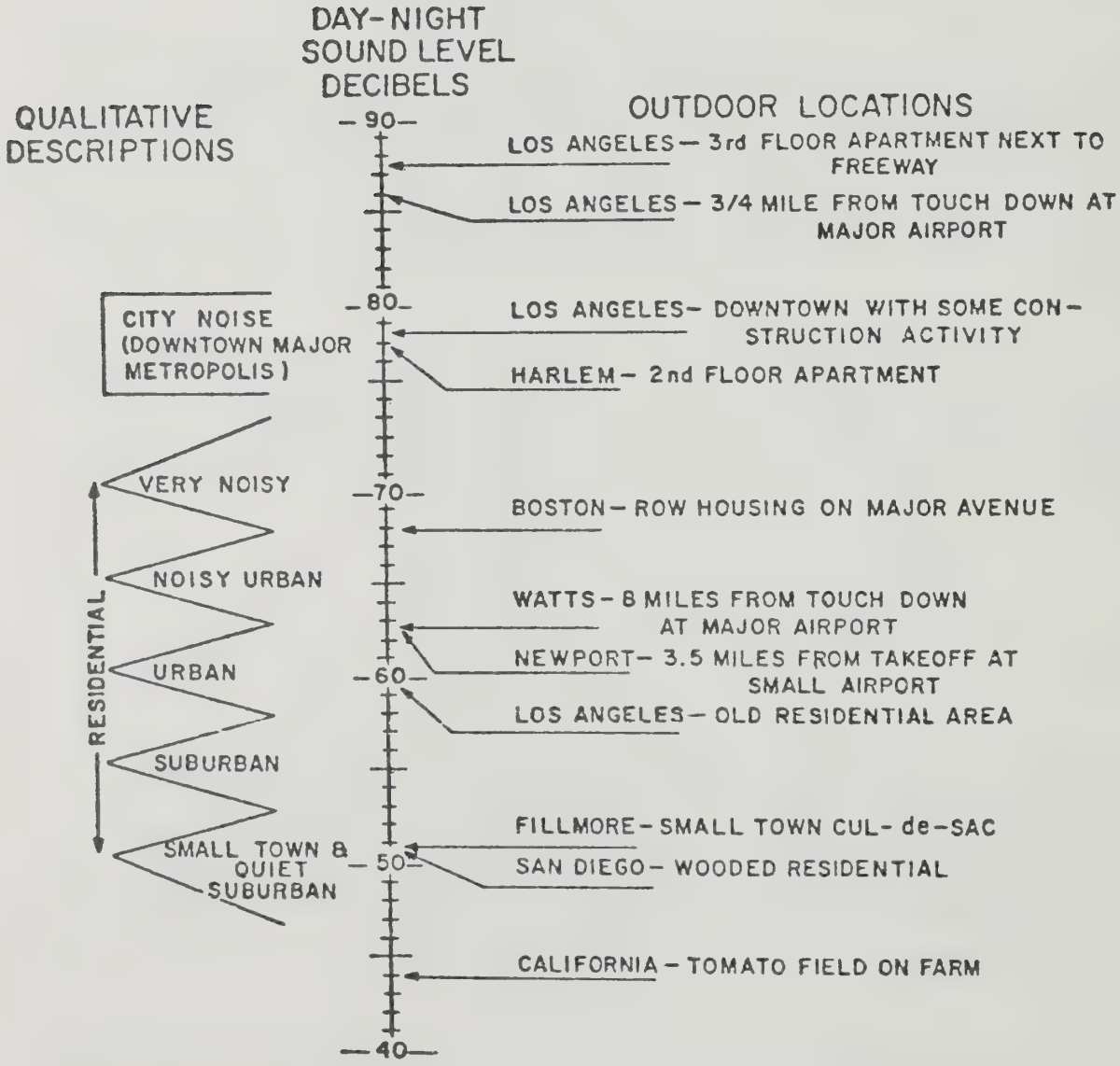
*Except for the method of treating nighttime noises, CNEL and L_{dn} are essentially the same. In CNEL, the 24-hour period is broken into three periods: Day (7a.m. - 7 p.m.), Evening (7 p.m. - 10 p.m.), and Night (10 p.m. - 7 a.m.). For most circumstances, the numerical difference between a two-period and three-period day are not significant, being of the order of several tenths of a decibel at most. In airport areas L_{dn} can be used interchangeably with CNEL if there are not a significant number of events that occur between the evening hours of 7:00 p.m. to 10:00 p.m.

Figure 6

EXAMPLES OF OUTDOOR DAY-NIGHT SOUND LEVEL (L_{dn})
MEASURED AT VARIOUS LOCATIONS



Source: U.S. Environmental Protection Agency, "Levels Document", March 1974, p. 20.

VII. WHY IS NOISE A PROBLEM?

The effects of noise on people range from annoyance and inconvenience to temporary or permanent hearing loss. The Environmental Protection Agency has stated that some 80 million people are significantly impacted by noise, half of whom are exposed to levels that can damage their hearing or otherwise affect their health.

Noise not only is detrimental to well-being, it is also costly. The World Health Organization has estimated that over $4 billion is spent by United States industry each year for noise-related absenteeism, reduced efficiency, workman's compensation claims, and mental illness.

One of the greatest problems in noise analysis is relating noise exposure to health and welfare, and determining adequate maximum noise levels for the protection of well-being. Despite a dispute in the scientific community regarding the detrimental effects of various levels of noise, some general conclusions have been reached:

(a) Noises of sufficient intensity have caused irreversible hearing damage.
(b) The effects of noise are cumulative and, therefore, the levels and durations of noise exposure must be taken into account in any overall evaluation. This realization has been translated into legislation.
(c) Noises have produced physiological changes.
(d) Noise can interfere with speech and other communication.
(e) Noise can be a major source of annoyance by disturbing sleep, concentration, rest, and relaxation.
(f) Noise interference with work is a significant cost of our industrial society.
(g) People often do not complain about noise despite its adverse impact on their health and general well-being.

A. IMPACT ON HEALTH AND SAFETY

1. Hearing Loss

Hearing loss is the major hazard of a noisy environment. High levels of noise or prolonged exposure to noise can cause hearing threshold shifts. This reduction in hearing acuity is called a "threshold shift" because its magnitude is measured by the change in the threshhold of hearing level. Threshold shifts range from a temporary change in hearing sensitivity in which complete recovery will occur, to shifts of such magnitude that hearing is permanently damaged. The frequencies (e.g., low, medium, or high pitches) necessary to produce threshold shifts vary from individual to individual.

Noise-induced temporary threshold shifts usually occur when sound levels exceed 60 to 80 decibels (dB), A-weighted scale. Threshold shift recovery time varies depending upon the sound level, frequency, duration, repetition of exposure, and individual noise sensitivity.

Recovery can be as short as one hour or as long as several days. Severe noise exposure can cause compound threshold shifts in which no recovery is possible, resulting in permanent hearing loss.

Permanent hearing loss is a well-substantiated occurrence in our society. Industrial settings account for the largest percentage of such noise-induced hearing loss.

The impact on workers' hearing ability of exposure to industrial environments at different noise levels, and in comparison to persons not so exposed, is illustrated in Figure 7. It shows the percentage of 6,835 tested industrial workers having hearing impairment as a function of age and noise exposure level. These workers are compared to 2,518 persons not exposed to such noise levels.

It has been estimated that six million American workers suffer from impaired hearing resulting from continuous high-intensity noise over their working years. A recent industrial noise conference reported that one out of four job applicants in industry has a hearing loss. As a measure of the impact, it should be noted that the number of hearing loss claims under workman's compensation laws is increasing today, and that the average settlement is out of court at about $3,000.

The United States Occupational Safety and Health Administration (OSHA) states the levels of noise to which the worker may be exposed and what the employer must do if these levels are exceeded. The standard (Table 9) permits an employee to work eight hours a day on a job where the sound intensity is 90 dBA. This exposure is considered to be the upper limit of a daily dose that will not produce disabling loss of hearing in more than 20 percent of a population exposed through a working lifetime of 35 years. Reduced exposure time is specified for greater intensities.

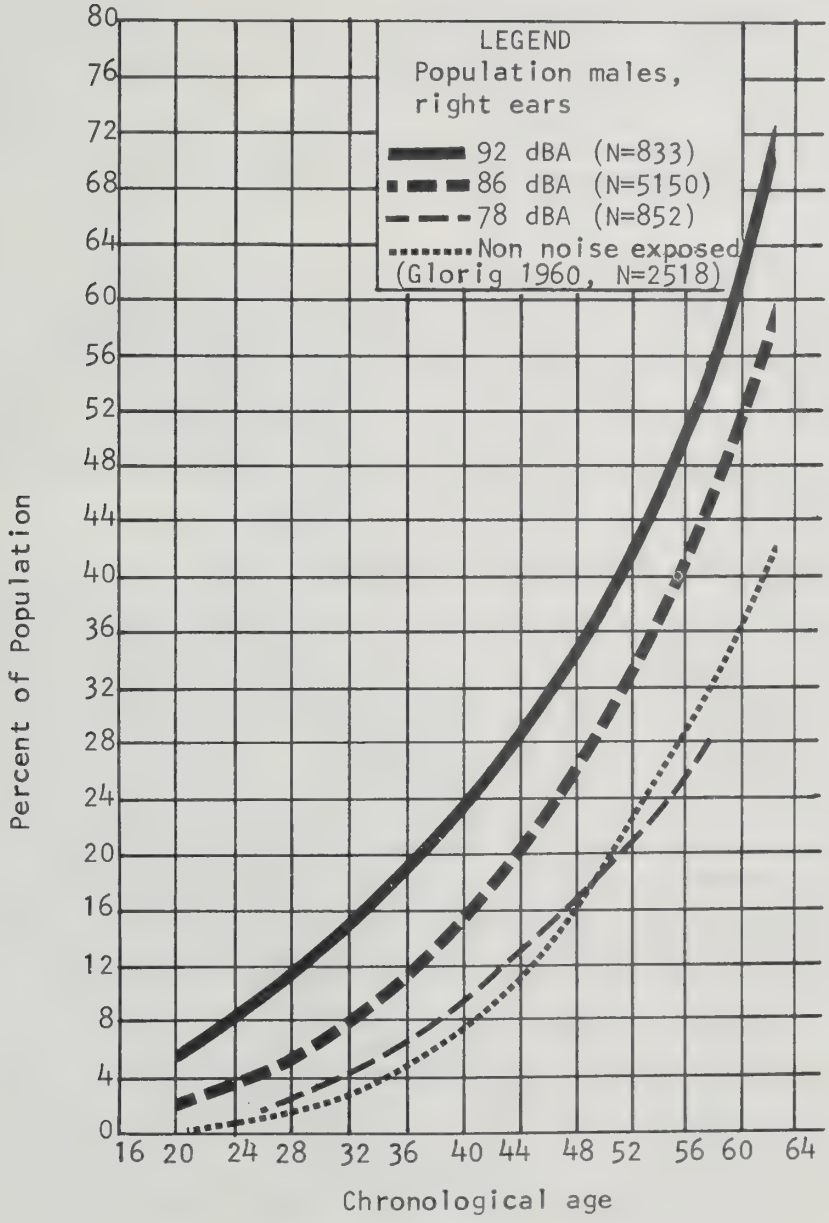
Table 9

PERMISSIBLE NOISE EXPOSURES

Duration Per Day, Hours	Sound Level dBA
8	90
6	92
4	95
3	97
2	100
$1\frac{1}{2}$	102
1	105
$\frac{1}{2}$	110
$\frac{1}{4}$	115

Figure 7

PERCENTAGE OF INDUSTRIAL WORKERS HAVING A SPECIFIC HEARING IMPAIRMENT AS A FUNCTION OF AGE AND NOISE EXPOSURE LEVEL



Source: Karl D. Kryter, The Effects of Noise on Man, 1970, p. 161.

Where permissible noise levels are exceeded, there are essentially three actions for an employer to take: reduce the noise at its source, reduce individual exposures, or provide ear-protective equipment. He must carry out a continuing program of hearing conservation, and this might well entail all three steps plus regular checks of effectiveness.

A number of sources suggest that the above "permissible" noise exposure levels fail to adequately protect a person's hearing. For example, the American Conference of Governmental Industrial Hygienists believes that the maximum noise exposure over a set time period should be reduced 5 dBA below the noise standards applied by the OSHA (i.e., 85 dBA for 8 hours, etc.). The Environmental Protection Agency (EPA) has identified 75 dBA as the maximum eight hour equivalent sound exposure level ($L_{eq(8)}$) to prevent hearing loss.*

Finally, there is the ultimate cost of hearing loss. It may seriously diminish a person's ability to earn a living. Hearing loss decreases job security and the choise of jobs available. The worker is barred from employment requiring an acute sense of hearing, for safety or other reasons. Similarly, discrimination because of alleged higher insurance costs is apt to occur. The deaf and hard of hearing have statistically held lower paying, less skilled jobs despite comparable intelligence to workers with normal hearing.

2. Physiological & Psychological Effects

Noise, as a factor in human stress, may contribute to the onset of seemingly unrelated diseases. Physiological responses to noise can be the immediate elements contributing to the development of progressive psychosomatic diseases. Unexpected noise may produce a rise in blood pressure, an increase in pressure in the head, greater heart and respiratory rates, and sharp muscular contractions. Digestive functioning and circulation to the extremities can be impeded. Peptic ulcers, high blood pressure, increased blood cholesterol, colitis, heart disturbances, migraine headaches, nervous disorders, and tiredness are some of the psychosomatic diseases associated with noise. This relationship between noise and certain physiological problems is strongly supported by a German study illustrated in Figure 8.

There is strong indication that noise is a factor in mental stress. Noise, however, is apt to be more an aggravator rather than a precipitator of behavioral disorders. Those persons that already have some mental health problems are more susceptible to the influence of noise. There is evidence that the rate of admissions to mental hospitals is higher from socio-economic areas with higher levels of noise.

Nevertheless, the causality between noise and these mental manifestations is difficult to establish. This difficulty arises from the multitude of other factors in an individual's environment at the moment of noise impact which could contribute to these adverse reactions.

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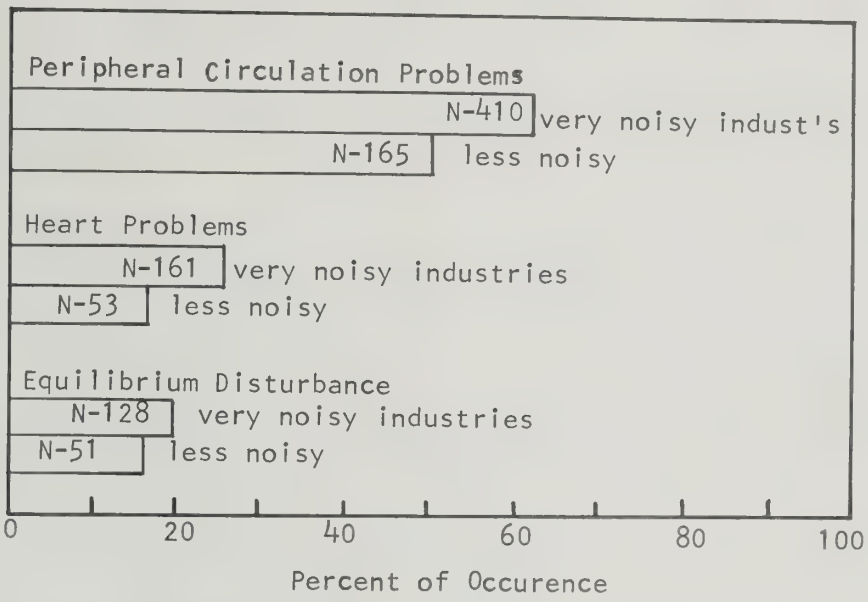
*See Appendix C.

Figure 8

DIFFERENCES IN PHYSIOLOGICAL RESPONSE TO NOISE BY TYPE OF INDUSTRY*



*Difference in percentage of occurrence of physiological problems in 1005 German industrial workers. The differences in peripheral circulation and heart problems in the two classes of industry were statistically significant.

Source: Karl D. Kryter, The Effects of Noise on Man, 1970, p. 509.

3. Safety

Safety of human life is occasionally threatened by noise. Fatalities occur when noise interferes with signals of warning. For example, accidents may occur when an emergency signal is drowned out by noise. Distracting noises from horns, aircraft, and construction equipment can mask out warnings from emergency and other vehicles. Noises generated inside cars and trucks oftentimes make it impossible for the driver to detect warning signals such as sirens.

B. NUISANCE EFFECT

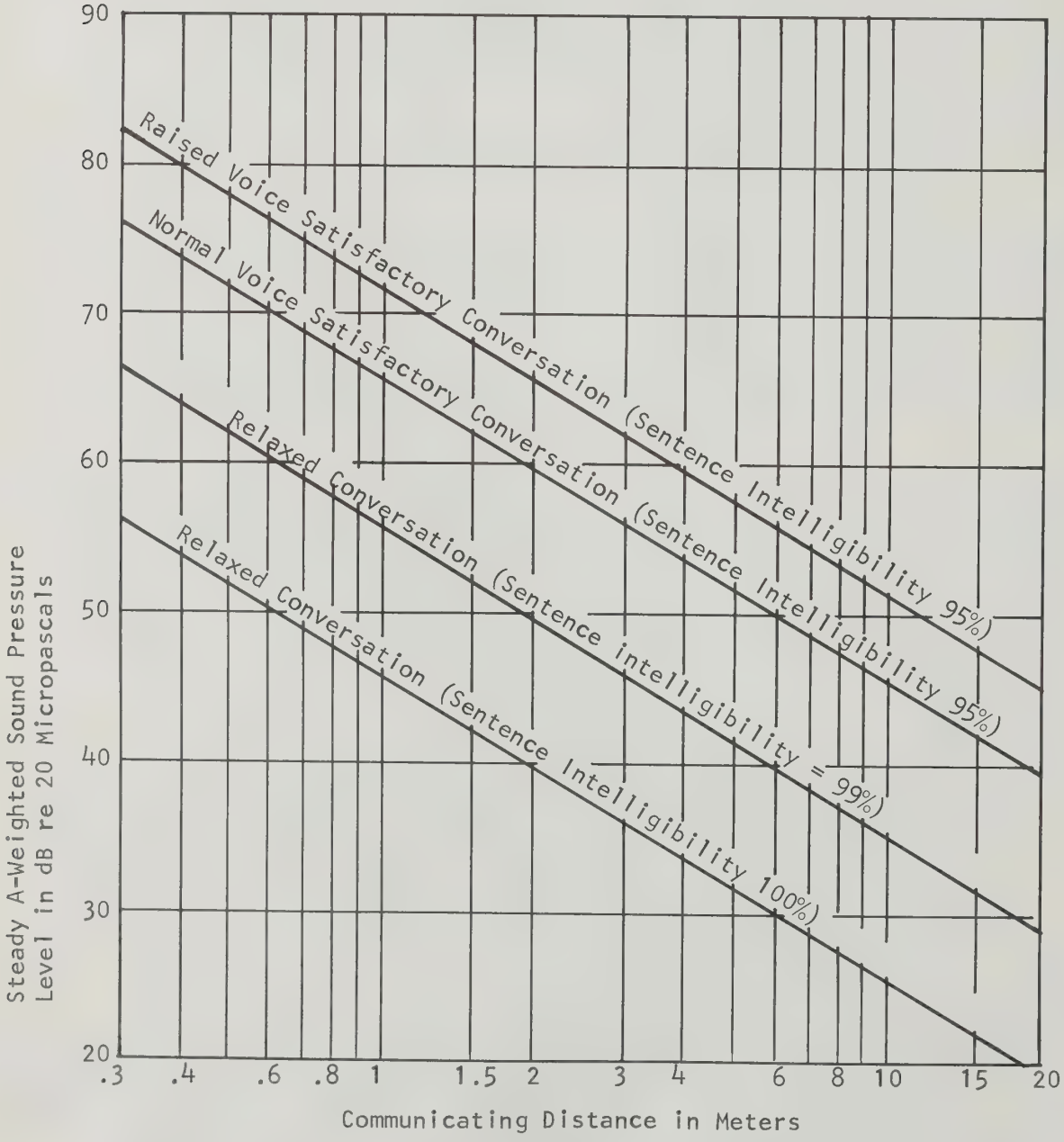
Noise is capable of interfering with most normal human activities, such as communication, sleep, and work. Overall efficiency and enjoyment of life may be reduced drastically. Noise may evoke feelings of resentment as it intrudes into people's lives. The results may be a significant deterioration of emotional and social well-being.

1. Communication

Noise causes interruption in our daily conversations. Interrupted conversations and messages improperly heard and acted upon exact costs

FIGURE 9

MAXIMUM DISTANCES OUTDOORS OVER WHICH CONVERSATION IS CONSIDERED TO BE SATISFACTORILY INTELLIGIBLE IN STEADY NOISE



Source: U.S. Environmental Protection Agency, "Levels Document," March 1974, p. D-9.

in time, material, and labor. Figure 9 indicates those decible (dBA) levels at various distances between talker and listener which permit face to face communication at different voice levels.

A special case where noise interference can be especially crucial, and is so recognized by the State of California, is in the classroom. Disruptions by noise in the schools can necessitate the repeating of material, can cause misunderstanding of assignments, and can make concentration difficult on complex matter.

2. Sleep

Sleep interference is probably the most commonly recognized effect of noise. Sleep is needed to maintain our physical and mental health. Noise intrusion can disrupt our sleep and deprive us of its recuperative value. The depth, continuity, and duration of sleep are all affected by noise disturbance.

The dream stage, the most essential state of sleep, accounts for twenty-five percent of adults' sleep time. The noise level required to disrupt this stage of sleep is relatively low. If this state is disrupted frequently, psychological damage and serious disturbances can result. Acute psychotic breakdown may result from the cumulative effect of numerous deprivations of dream sleep.

A noisy environment can also affect the quality of sleep. Falling asleep may be a lengthy and tedious process and deep sleep may only come in short intervals. Physical fatigue during the working hours is the usual result.

3. Work

Noise interference with work is more subtle and less understood than noise impact on communication and sleep. The ability to do tasks, especially complicated ones, is made more difficult under conditions of high noise levels. Business efficiency, cost, and output are all affected. Those tasks requiring higher order mental facilities, such as creative thinking and problem solving, are most susceptible to noise disruption. The ability to perceive ideas and retrieve thoughts is slowed under a noisy environment.

4. Need for a Quiet Home Environment

A quiet home helps the individual cope with the less controllable noises and other stresses encountered throughout the day's activities.

Auditory privacy at home is being constantly and increasingly challenged by unwanted sounds because noise possesses a penetrative character that respects few boundaries. First evidence of these challenges is the relatively increasing number of multi-family structures in comparison to single family dwellings. In multi-family buildings, the provision of auditory privacy is more difficult vis-a-vis other adjacent or nearby units. A second trend is toward using lightweight construction materials that have relatively poor sound insulating properties. If this trend

continues without modification of sound insulating properties, future homes will have far less privacy than did past homes.*

C. ECONOMIC IMPACT

Noise control should be brought about where it is least costly and most effective from an overall viewpoint. This point may be at the source, the place of impact, in between, or some combination of these.

Estimates have been made of the relative cost-effectiveness of alternative methods for reducing noise impact. Around airports, reduction of noise at the source (i.e., quieter engines) has been shown to be generally more cost-effective than reducing impact by land acquisition. Although for residential land most drastically impacted by aircraft noise, the opposite may be true. Along freeways, new designs utilizing sound barriers are more cost-effective in reducing freeway noise impact. Vehicle noise reduction at the source is probaly least cost-effective. However, such reduction creates significant benefits in other areas of vehicle movement off the freeway. Thus, a balanced approach for reducing noise impact along the highway transportation system would emphasize both vehicle noise reduction and improved freeway design.

It is expensive to control noises at their source. Manufacturers of the machinery of technical society commonly cite these economic costs as if they were justification for doing nothing. Nevertheless, it is frequently less costly to design in noise control at the design stage of buildings, equipment, and products than to provide noise insulation after noise pollution has become stark reality. Manufacturers commonly feel little pressure to design noise control into the noise source because these larger, after-the-fact noise control costs are usually charged to society as a whole rather than to the manufacturer who created the noise source in the first place.

Excessive noise impacts can drastically reduce property values.** Property may be limited to certain kinds of economic activity because of noise impacts. This impact can apply to land uses such as public buildings, churches, schools, homes, and even certain industrial buildings. The most commonly affected property is residential. These impact costs have traditionally been passed on from the producer of the noise to those in the vicinity where the impact occurs or to the public in the form of tax-financed noise barriers or property acquisition.

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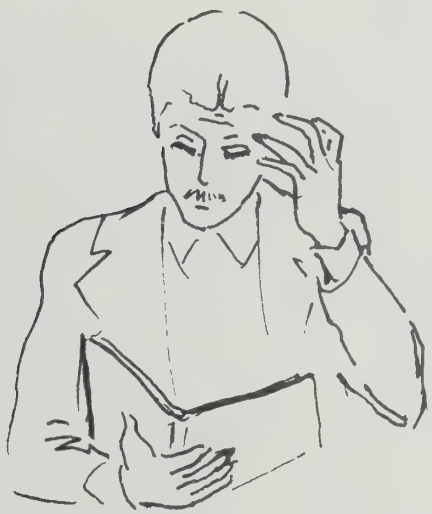
*Appendix C presents the EPA's view of the maximum levels of environmental noise for different land uses. These levels are supposed to protect public health and welfare, with an adequate margin of safety, from both activity interference (nuisance) and hearing loss.

**In an analysis made in Inglewood, California, it was calculated that on the average, residential land values were approximately 50% higher in areas where aircraft noise was low compared to areas where such noise was high. Similarly, rental dwelling vacancy rates were 50% higher in areas of high aircraft noise as compared to those areas where aircraft noise was low.

Until recently, these costs to society of excess noise were practically ignored by the economists. They were referred to as "external diseconomies" with no direct impact on the producer's profit margin. However, a mounting flood of lawsuits based on taking of property and lowered property values has brought these costs sharply in focus for both noise producers and economists. Hopefully, the cost of noise control at the source will now be seen as more profitable (i.e., "cost effective") than in the past.

A look at hearing loss, the worst possible type of noise impact, may clarify these "external diseconomies" for Santa Clara County. If Santa Clara County follows the national average, over 40,000 persons (4 percent) suffer some sort of hearing loss. If all these persons were compensated at rates similar to the provisions of California disability insurance for a period of 20 years, the cost would be about $6 billion.



Creative thinking and problem solving are most susceptible to noise disruptions

GLOSSARY

1. A-Weighted Sound Level (dBA) - The sound level measured on an instrument containing the "A" filter. The "A" filter electronically simulates the frequency response of the human ear under an average intensity of sound.

2. Ambient Noise - Ambient noise is the all encompassing noise associated with a given environment, being usually a composite of sounds from many sources near and far.

3. Audible Range of Frequency - The normal frequency range of human hearing encompassing 16 Hz to 20,000 Hz.

4. Average Daily Traffic (ADT) - The arithmetic mean of daily traffic volumes usually for a period of one year.

5. Background Noise - Background noise is a total of all sources of interference in a system used for the production, protection, measurement, or recording of a signal independent of the presence of the signal. In the urban environment, background noise is usually referred to as the urban "roar".

6. Community Noise Equivalent Level (CNEL) - The summation of all energy for a 24-hour day divided by the total number of seconds in a 24-hour day. The CNEL represents the average continuous noise level over a 24-hour period with special weighting factors applied to noise events occurring in the nighttime (10 p.m. to 7 a.m.), the evening (7 p.m. to 10 p.m.), and the daytime (7 a.m. to 7 p.m.).

7. Composite Noise Rating (CNR) - A 24-hour noise exposure index used for evaluating noise impact around airport facilities. It is primarily utilized by the Department of Defense in predicting noise environments around military airfields. Similar, mathematically to CNEL but without single event duration correction, no accountability for evening weighting, and a different nighttime weighting.

8. Day-Night Average Sound Level L_{dn}) - The A-weighted average sound level in decibels (re 20 micropascals) during a 24-hour period with a 10 db weighting applied to nighttime sound levels (10 p.m. to 7 a.m.). This exposure method is similar to the CNEL but deletes the evening time period (7 p.m. to 10 p.m.) as a separate factor.

9. Decibel - The decibel (abbreviated "dB") is a measure, on a logarithmic scale, of the magnitude of a particular quantity (such as sound pressure, sound power, intensity, etc.) with respect to a standard reference value.

10. Equivalent Sound Level (L_{eq}) - The level of a constant sound, which over a given time interval and situation has the same sound energy as a time-varying sound.

11. Frequency - The frequency of a function periodic in time is a reciprocal of the primitive period. The unit is a cycle per unit time or the hertz (Hz).

12. L_x - The representation of the general statistical sound level forms associated with ambient noise. The subscript "x" represents the percentile value of the sound level. Levels in common use are L_{10}, L_{50} (median), L_{90} (residual), L_{eq} (equivalent).

    L_{10} - The sound level exceeded 10% of the time. Corresponds to peaks of noise in the time history of environmental noise in a particular setting.
    L_{50} - The sound level exceeded 50% of the time. Corresponds to the average level of noise in a particular setting, over time.
    L_{90} - The sound level exceeded 90% of the time. Corresponds to the residual noise level.

13. Major Arterial - An arterial street of four or more lanes usually with an Average Daily Traffic volume in excess of 10,000 and providing through traffic movement between areas and across the City, generally with direct access to abutting property.

14. Modal Noise Level - The most frequently occurring noise level in any specified time interval.

15. Noise - Annoying, harmful or unwanted sound.

16. Noise Attenuation - The ability of a medium to reduce the level of a noise source, specified in decibels (dB) of transmission loss usually in octave frequency bands.

17. Noise Contour - A line connecting points of equal noise level as measured on the same scale.

18. Noise Exposure Forecast (NEF) - A 24 hour noise exposure index similar to CNR but with corrections for single event duration and pure tone components in sound source spectrum. Used almost exclusively for characterizing community impact to aircraft noise.

19. Noise Exposure Index (NEI) - The general mathematical form for L_{eq}, CNEL, CNR, NEF, and L_{dn}.

20. Noise Impact Area - The total area enclosed within any specific noise contour less the area of compatible land use inside the same contour. The exact contour value depends on the particular case under analysis.

21. Noise Performance Standards - A standard based on permitted emissions rather than on the category or type of land use.

22. Noise Sensitive Land Uses - Noise sensitive land uses include but are not limited to: residential, hospitals, schools, libraries, churches, unsoundproofed offices, hotels and motels and outdoor recreational areas. The use of land in which individuals are or can be particularly affected by noise is determined by such factors as psychological impairment, sleep disturbance, speech and talk interference and annoyance.

23. Maximum Noise Level - The maximum instantaneous level that occurs during a specified time interval. In acoustics, maximum sound pressure is to be understood for single events unless some other kind of level is specified.

24. Residual - Residual noise is the definition used to specify the statistical parameter L_{90}. It generally means the same thing as the term "background noise."

25. Sound - (1) Sound is an oscillation in pressure, stress, particle displacement, particle velocity, etc., in a medium with internal forces (e.g., elastic, viscus), or the super position of such propagated oscillations. (2) Sound is an auditory sensation invoked by the oscillation described above.

26. Sound Level Meter - a measurement instrument, containing a microphone, an amplifier, an output meter, and one or more frequency weighting networks which is used for the determination of noise and sound levels.

27. Transportation - In this document, this term includes facilities (airports, highways, railroads), vehicles (airplanes, cars and trucks, etc.), and the interaction between them (i.e., wheels rolling on a highway surface).

APPENDIX A

Tables a, b, and c summarize the measurement survey by land use. There are three categories, Residential/Rural, Recreation/Rural and Industrial. Within each category, an attempt is made to further define the specific nature of the site. For example, Site 1 is currently vacant. However, Site 1 is included in the Residential/Rural category due to its proximity to existing residential land use. Additionally, Site 56 is currently in agricultural land use, but the site is impacted by noise from weekend recreationally oriented traffic.

As can be seen on Tables a, b, and c traffic is the greatest contributor to noise everywhere in the Santa Clara County region. It would be a futile task to attempt to isolate typical noises for specific land uses. Therefore, it would be an unrealistic exercise to attempt to give a range of noise that can be expected for any particular land use within the County.

Table d indicates those areas impacted by freeway noise. It becomes apparent that L_{dn} noise levels of 50-75 L_{dn} can be expected within freeway environs.

Appendix A

Table a. NOISE EXPERIENCED BY LAND USE

RESIDENTIAL/RURAL

Site No.	LAND USE	L_{dn} RANGE	SOURCE
1.	Open Space	65-75 L_{dn}	Freeway Traffic
3.	Open Space/Agriculture	45-55 L_{dn}	Tractor, distant traffic
5.	Diary/Milking Activity	44-55 L_{dn}	Farm Machinery/traffic
6.	Open Space	65-70 L_{dn}	Traffic
8.	Open Space/School	50-55 L_{dn}	Freeway Traffic
11.	Residential/Rural	50-57.5 L_{dn}	Traffic
13.	Kennels/Rural	35-45 L_{dn}	Traffic (55-57.5 L_{dn})
14.	Open Space/Vineyard	40-45 L_{dn}	Traffic/Airplanes
16.	School/Rural	40-42.5 L_{dn}	Natural Noise
18.	South County Government Building	57.5-60 L_{dn}	Traffic/Train
20.	School/Urban	55-60 L_{dn}	Traffic
24.	Residential/Rural	40-40 L_{dn}	Natural Noise
25.	Agriculture	35-50 L_{dn}	Traffic
29.	Agriculture	45-50 L_{dn}	Wind
33.	Residential/Rural	44-48 L_{dn}	Traffic
34.	Residential/Rural	40-45 L_{dn}	Traffic
35.	School/Rural	40-45 L_{dn}	Ventilation equipment
36.	Residential/Rural	45-50 L_{dn}	Community noise/traffic
40.	Agriculture	45-50 L_{dn}	Cows/Traffic
42.	Residential/Rural	62.5-65 L_{dn}	Freeway traffic
44.	Residential	55-60 L_{dn}	Traffic/Trucks
47.	School/Rural	45-50 L_{dn}	Natural noise/traffic
49.	Rural Open Space	55-60 L_{dn}	Traffic
50.	Commercial/Rural	55-60 L_{dn}	Traffic
51.	Rural/Open Space	55-60 L_{dn}	Traffic

Table b. NOISE EXPERIENCED BY LAND USE

RECREATIONAL/RURAL

Site No.	LAND USE	L_{dn} RANGE	SOURCE
4.	Agriculture/Rural	40-42.5 L_{dn}	Cows/Traffic/Shooting
7A.	Park/Commercial	55-57.5 L_{dn}	Traffic
7B.	Recreational Vehicle Park	52.5-55 L_{dn}	Local noise/Traffic
9.	Stables	45-55 L_{dn}	Traffic
15.	Park/Rural	50-55 L_{dn}	Horse show/P.A. system
21.	Golf Course	45-50 L_{dn}	Aircraft/Traffic
22.	Rural/Open space (Anderson Res.)	45-50 L_{dn}	Traffic
23.	Rural/Open space	35-37.5 L_{dn}	Aircraft
26.	Residential/Shooting range	45-50 L_{dn}	Shooting (67 L_{dn})/Aircraft
27.	Proposed Park/Solid Waste Facility	50-55 L_{dn}	Traffic
28.	Motor sports/Rural	45-50 L_{dn}	Cows/Aircraft/Traffic
32.	Boat launching ramp	50-55 L_{dn}	Freeway Traffic
37.	Marina	50-55 L_{dn}	Boat launching
39.	Park	55-60 L_{dn}	Traffic
45.	Stables	42-47 L_{dn}	Traffic
48A.	Park/Rural	50-55 L_{dn}	Rushing creek water/Traffic
48B.	Park/Rural	37.5-40 L_{dn}	Aircraft Traffic
52.	Park/Rural	45-50 L_{dn}	Traffic
53.	Park/Rural	50-55 L_{dn}	Traffic
56.	Agricultural/Rural	55-60 L_{dn}	Tractor
57.	Park/Reservoir	50-52 L_{dn}	Boat launching/Motorcycles

Appendix A

Table c. NOISE EXPERIENCED BY LAND USE

INDUSTRIAL/RURAL

Site No.	LAND USE	L_{dn} RANGE	SOURCE
2.	Food processing/Rural	67-67.5 L_{dn}	Food factory processing/Traffic
10.	Industrial	50-55 L_{dn}	Highway traffic
12.	Sand and Gravel Extraction	45-50 L_{dn}	Traffic
19.	Commercial/Industrial	65-70 L_{dn}	Freeway traffic
31A.	Quarry	42.5-45 L_{dn}	Urban Noise
31B.	Quarry	47.5-50 L_{dn}	Aircraft
38A.	Solid waste disposal	47.5-50 L_{dn}	Operation noise/traffic
38B.	Solid waste disposal	57.5-60 L_{dn}	Trucks/Operation noise
41.	Solid waste disposal	47.5-50 L_{dn}	Trucks/Operation noise
43.	Cement Batch Plant	55-55 L_{dn}	Operation noise/traffic
46.	Quarry	65-70 L_{dn}	Trucks/Operation noise
54.	Quarry	45-50 L_{dn}	Trucks
55.	Speedway/Residential	65-75 L_{dn}	Oval and figure 8 races

Table d. SITES IMPACTED BY FREEWAY NOISE

Site No.	RESIDENTIAL RANGE	Site No.	RECREATIONAL RANGE	Site No.	INDUSTRIAL RANGE
1	65-75 L_{dn}	27	50-55 L_{dn}	10	50-55 L_{dn}
11	50-57.5 L_{dn}	32	50-55 L_{dn}	19	65-70 L_{dn}
20	55-60 L_{dn}				
42	62.5-65 L_{dn}				

Appendix B

(From Land Use Plan for Area Surrounding Santa Clara County Airports, August 1973)

Table a

NOISE REDUCTION AFFORDED BY COMMON BUILDING CONSTRUCTION
ASSUMING NO SPECIAL NOISE CONTROL PROVISIONS

Construction Type	Typical Occupancy	General Description	Range of Noise Reduction, dBA
1	Residential, Commercial, Schools	Wood framing. Exterior stucco or wood sheathing. Interior drywall or plaster. Sliding glass windows. Windows partially open.	15 - 20
2	Same as 1, above	Same as 1 above, but windows closed	25 - 30
3	Commercial, Schools	Same as 1 above, but windows are fixed 1/4 inch plate glass	30 - 35
4	Commercial	Steel or concrete framing. Curtain-wall or masonry exterior wall. Fixed 1/4 inch plate glass windows	30 - 40

The range depends upon the openess of the windows, the degree of seal and the window area involved.

Appendix B

(From Land Use Plan for Area Surrounding Santa Clara County Airports, August 1973)

Table b. GENERAL CONSTRUCTION METHODS TO ACHIEVE THE INDICATED EXTERIOR NOISE REDUCTION

Required Overall Bldg. Noise Reduction (dBA)	FLOOR	EXTERIOR WALLS	EXTERIOR DOORS	WINDOWS	CEILING, ROOF
30	No special provisions	No special provisions, eliminate penetrations of wall air conditioning units, etc.	Solid core, weatherstripping	Seal	Generally, no special provisions.
40	a. Slab on grade-no special provisions b. If raised floor, one or more of the following: 1. vent baffling 2. attach gypboard to under side of floor joists	No special provisions in most cases. Eliminate penetrations of wall air conditioning units, etc.	Sound doors, sound seals	Double glazing, sealed windows	a. Attic System 1. vent baffling 2. sound absorption between beams b. If beam ceiling: 1. provide sound absorption between joists 2. provide gypboard on resilient clips to under side of beams
50	a. Slab on grade-no special provisions b. If raised floor: 1. vent baffling 2. provide sound absorption between floor & joists 3. add gypboard to under side of floor joists	a. Wood framing-staggered studs with sound absorption in cavity. Stucco on outside, 2 layers gypboard on inside. b. 8 in. concrete block with sealed exterior & interior surfaces. c. 4 in. dense concrete	Special sound doors with acoustical seals	Double glazing, sealed windows, minimum 4 in. airspace	a. Attic System 1. vent sound traps 2. independently framed ceiling & roof system 3. sound absorption in attic space b. Built up roof over 4 in. concrete slab with suspended ceiling
60	a. Slab on grade-no special provisions b. If raised floor: similar to NR-50 requirement except more effective vent baffling; attach gypboard to floor joists by resilient clips	a. Wood or steel stud framing-double studs with multi-layer gypboard on both sides, exterior stucco or sheathing. Sound absorption in air cavity. b. 12 in. dense concrete c. 4 in. concrete with separate furred multi-layer gypboard wall. Sound absorption in air cavity.	Two solid core weatherstripped doors with sound lock	Barely practical. Minimize window area. Double glazing with acoustical glass and 8 in. airspace. Avoid windows on noise exposure side. Arrange windows on interior encl. court, etc.	a. Attic System, similar to NR-50 requirement but more mass b. 4 in. concrete slab with vibration isolated ceiling

Appendix C

YEARLY AVERAGE EQUIVALENT SOUND LEVELS IDENTIFIED AS REQUISITE TO PROTECT THE PUBLIC HEALTH AND WELFARE WITH AN ADEQUATE MARGIN OF SAFETY

		INDOOR			OUTDOOR		
	MEASURE	Activity Interference	Hearing loss consideration	To protect against both effects (b)	Activity Interference	Hearing loss consideration	To protect against both effects (b)
Residential with outside space and farm residences	L_{dn} $L_{eq(24)}$	45	70	45	55	70	55
Residential with no outside space	L_{dn} $L_{eq(24)}$	45	70	45			
Commercial	$L_{eq(24)}$	(a)	70	70(c)	(a)	70	70(c)
Inside transportation	$L_{eq(24)}$ $L_{eq(24)}$	(a)	70	(a)			
Industrial	$L_{eq(24)}$ (d)	(a)	70	70(c)	(a)	70	70(c)
Hospitals	L_{dn} $L_{eq(24)}$	45	70	45	55	70	55
Educational	$L_{eq(24)}$ $L_{eq(24)}$ (d)	45	70	45	55	70	55
Recreational areas	$L_{eq(24)}$	(a)	70	70(c)	(a)	70	70(c)
Farm land and general unpopulated land	$L_{eq(24)}$				(a)	70	70(c)

Explanation of identified level for hearing loss: The exposure period which results in hearing loss at the identified level is a period of 40 years.

Code: (a) Since different types of activities appear to be associated with different levels, identification of a maximum level for activity interference may be difficult except in those circumstances where speech communication is a critical activity.
(b) Based on lowest level.
(c) Based only on hearing loss.
(d) An $L_{eq}(8)$ of 75 dB may be identified in these situations so long as the exposure over the remaining 16 hours per day is low enough to result in a negligible contribution to the 24-hour average, i.e., no greater that an L_{eq} of 60 dB.

Source: U.S. Environmental Protection Agency, "Levels Document", March 1974, p. 40.

Appendix D

POLICY FOR THE INSTALLATION OF FENCING AND NOISE ATTENUATION-BUFFERING DEVICES ON COUNTY EXPRESSWAYS

In order to provide enforced observance of acquired access rights on expressways, provide for the general safety of people using expressways and lands adjacent to expressways, and mitigate noise levels on lands adjacent to expressways, the County policy on fencing and noise-buffering devices shall be as follows:

1. Access Control and Safety Fencing Installation Policy

   Six-feet high chain link fencing shall be installed at County expense to preserve access rights observance and to provide for the safety of both the users of lands adjacent to expressways and the users of expressways in accordance with the following criteria:

Degree/Type of Access Control	Fencing Policy
A. Full access rights purchased.	Full fencing installed.
B. Partial access rights purchased.	Partial fencing installed.
C. Full/partial access acquired by land development proceedings with a frontage road adjacent to the expressway.	Full/partial fencing installed.
D. Full/partial access acquired by land development proceedings without a frontage road adjacent to the expressway.	Full/partial fencing installed in residential use property.
E. Land acquired without access rights being acquired.	No fencing installed.

2. Noise Attenuation-Buffering Devices Installation Policy

   A. General Considerations:

   The Department of Public Works will cooperate with the affected cities and land owners/developers in mitigating noise levels on lands adjacent to the expressway system. A goal of this policy is to encourage cities and land owners/developers to provide noise mitigating measures in land development policies in order that noise levels are at or below accepted standards. In the event studies indicate that noise levels will exceed the following listed standards 10 percent of the time (L10) during the peak hour traffic, and that significant reductions in the noise level can be achieved through the installation of an attenuation-buffering device, the Department of Public Works will allocate funds for the installation of the attenuation-buffering devices for land use categories B and E as follows:

Land Use Category	Design Noise Levels	Examples
B	70 dBA (exterior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, picnic areas, recreation areas, playgrounds, active sports areas and parks.
E	55 dBA (interior)	Inside public meeting rooms, schools, churches, libraries, hospitals and similar public buildings.

B. New Expressways:

Special consideration of noise mitigation measures will be included in the design process for new expressways. Where prior category B/E land use exists adjacent to a new expressway, the County will include in its construction plans the installation of a noise attenuation-buffering device to be fully paid for by the County.

C. Existing Expressways:

The County will install/participate in noise attenuation-buffering devices for land use categories B/E that are adjacent to existing expressways as follows:

(1) Expressway exists prior to proposed land use

Where an expressway exists prior to proposed category B/E type development, the County will contribute the equivalent cost of a chain link fence (regardless if a chain link fence exists or not) to the developer towards the installation of a noise attenuation device that is acceptable to the Public Works Department.

(2) Improvement of an existing expressway

Where the County is proposing an expressway improvement project, the County will include in its plans and specifications the installation of a noise attenuation-buffering device to be fully paid for by the County.

(3) Existing expressway adjacent to existing land use

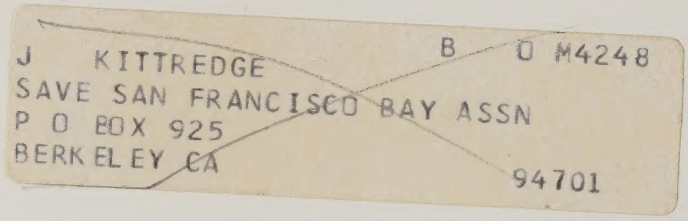
Where an existing expressway is adjacent to existing category B/E type land use and half of the adjacent property owners between two adjacent public street openings to the expressway desire the installation of a noise attenuation-buffering device, this area will be included in a County program of installation of attenuation-buffering devices to be fully paid for by the County.

3. Enhanced Access Control Facility Installation Policy

Where existing/proposed land use categories B/E that are adjacent to the expressways fall within the above-mentioned access control and safety fencing installation policy (#1), but are below the noise level criteria in the above-mentioned noise attenuation-buffering devices installation policy (#2), the County will participate in installation of enhanced access control facilities in accordance with the following criteria:

When more than one-half of the adjacent and/or directly affected property owners between two adjacent public street openings to the expressway desire the installation of an enhanced access control facility, the cost to the County of such installation shall be the equivalent cost of a chain link fence (regardless if a chain link fence exists or not).

COUNTY OF SANTA CLARA
PLANNING DEPARTMENT
County Government Center
East Wing, Sixth Floor
70 West Hedding Street,
San Jose, California 95110



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